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**Gass et al.**

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(54) **TABLE SAWS WITH SAFETY SYSTEMS AND SYSTEMS TO MOUNT AND INDEX ATTACHMENTS**

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***B27G 19/02*** (2006.01)
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(52) **U.S. Cl.**
USPC ..... **83/102.1**; 83/440.2; 83/477.2; 83/478

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USPC ..... 83/102, 820, 102.1, 478, 823, 440.2, 83/544, 477.2, DIG. 1; 403/DIG. 4; 144/307, 144/308, 251.1–251.3, 278.1; 269/229–236
See application file for complete search history.

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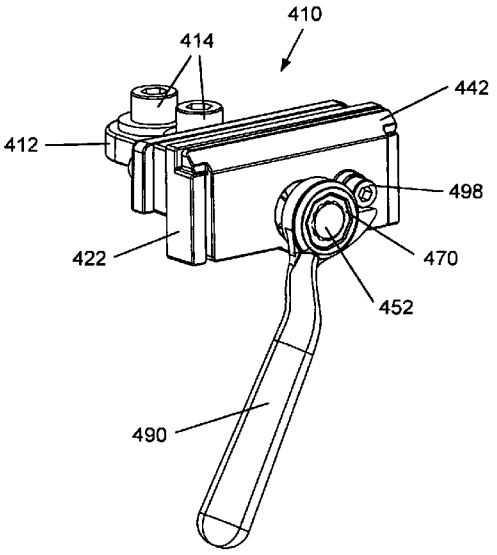
(57) **ABSTRACT**

Table saws and table saws designed to implement safety systems that detect contact between a person and a dangerous portion of the saw are disclosed. Table saw components, mounting systems for table saws, and table saw attachments are also disclosed. One embodiment may include a first clamp surface, a second clamp surface spaced apart from the first clamp surface so that a base portion of a riving knife or splitter can be placed between the clamp surfaces with the opposing sides of the base portion generally parallel to the first and second clamp surfaces.

**2 Claims, 44 Drawing Sheets**



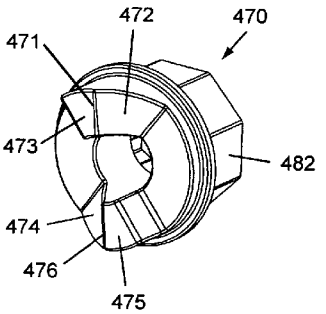



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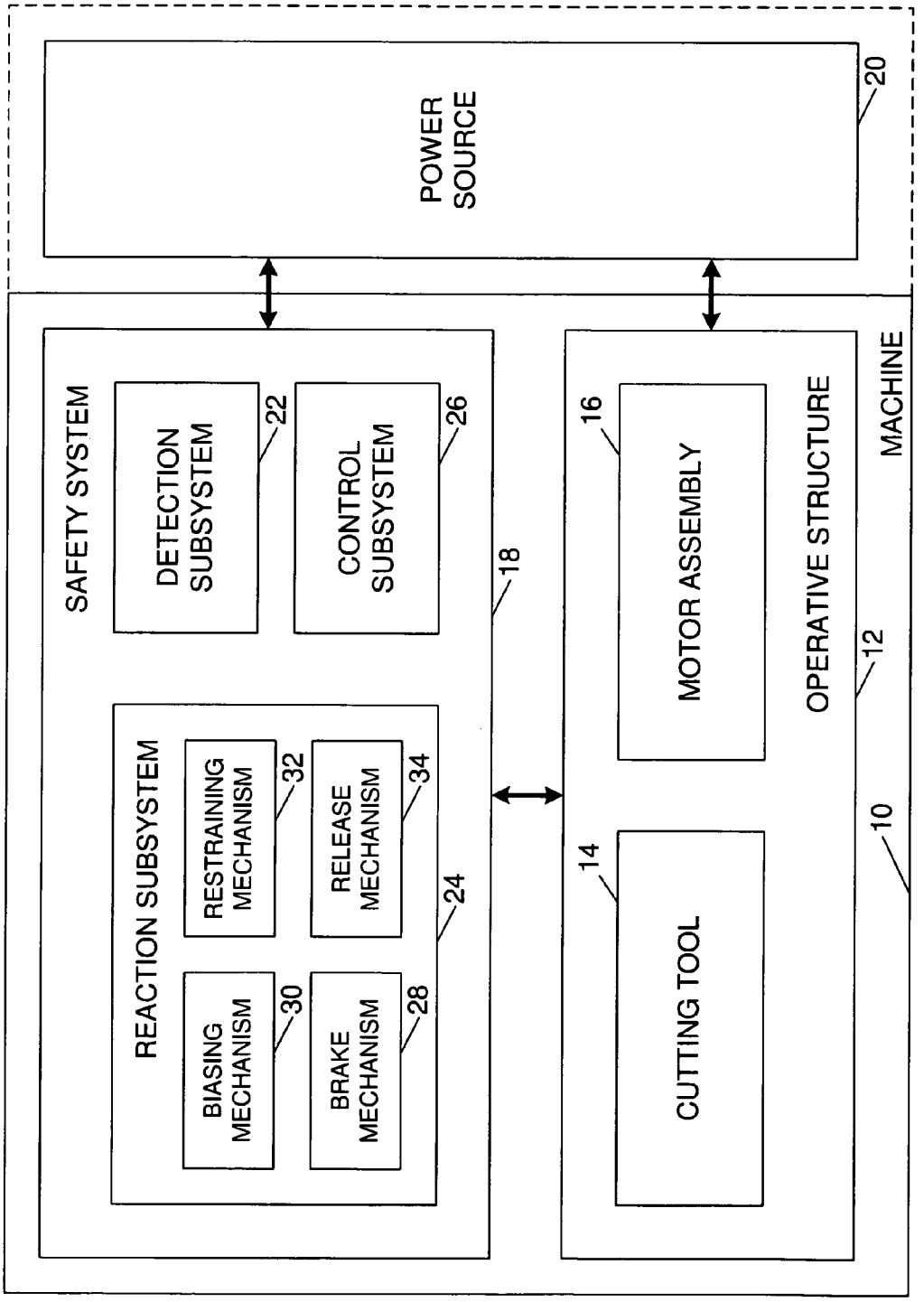
Fig. 1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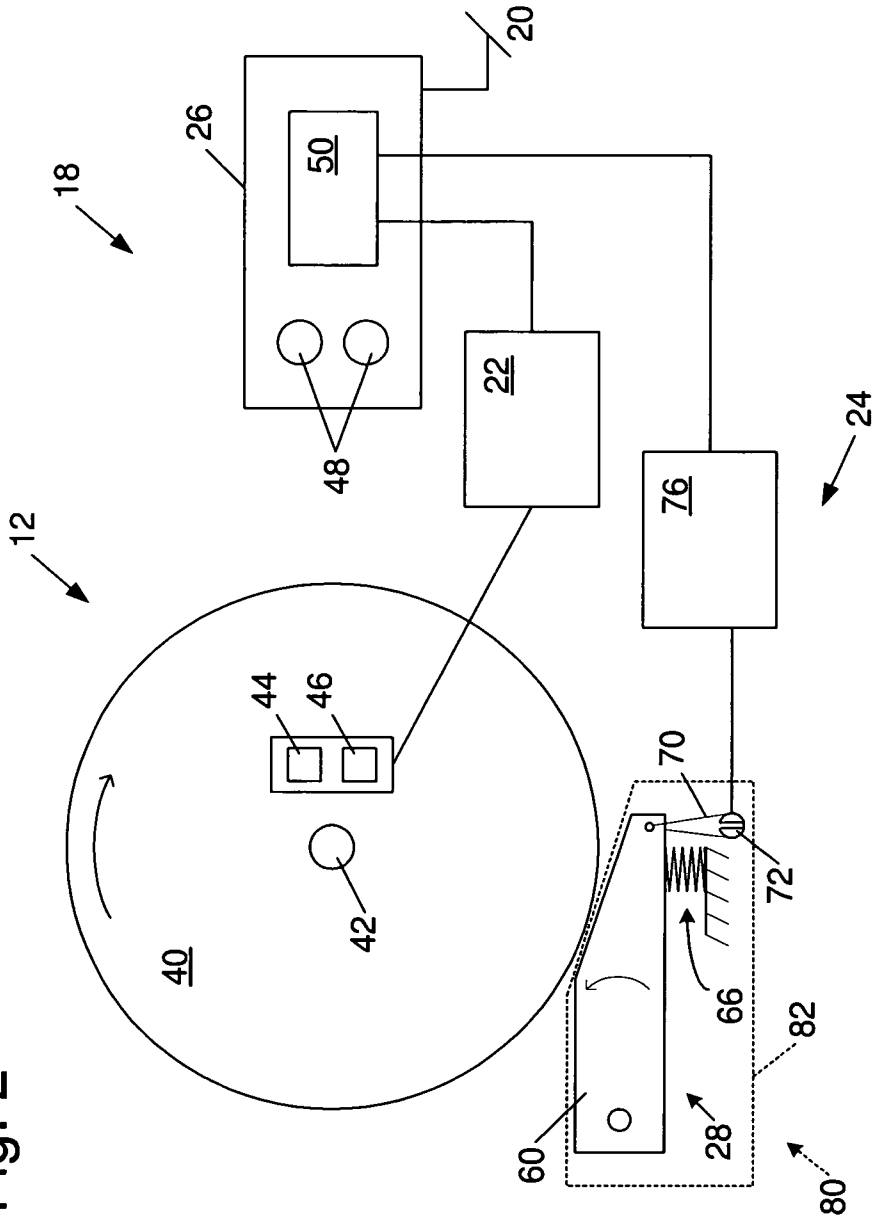


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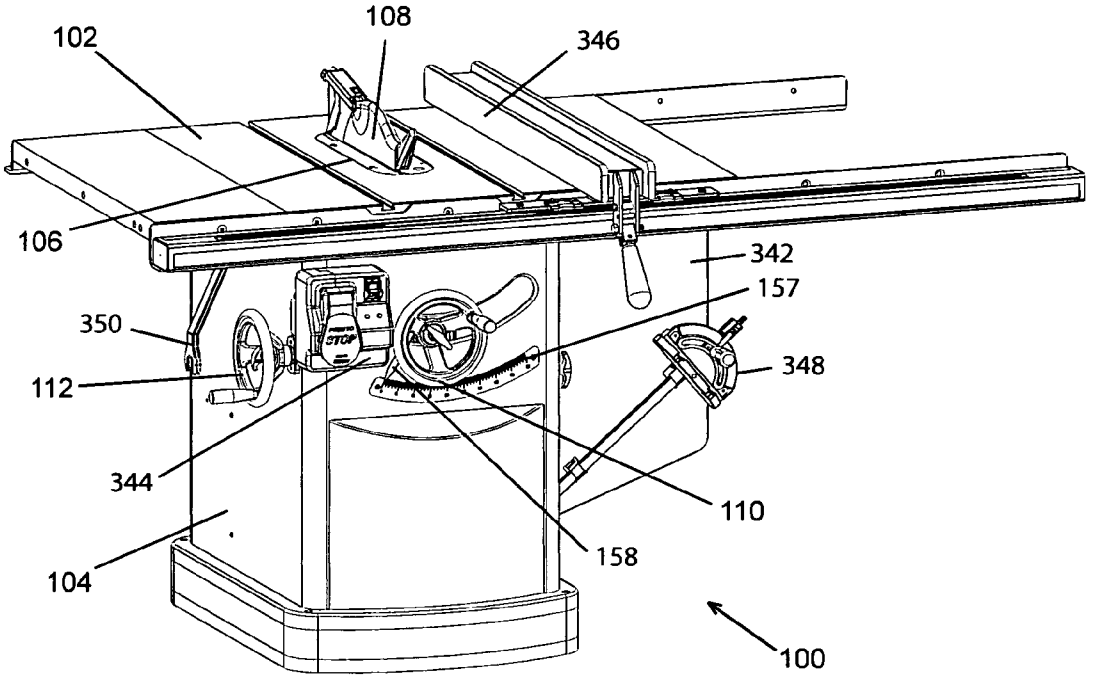


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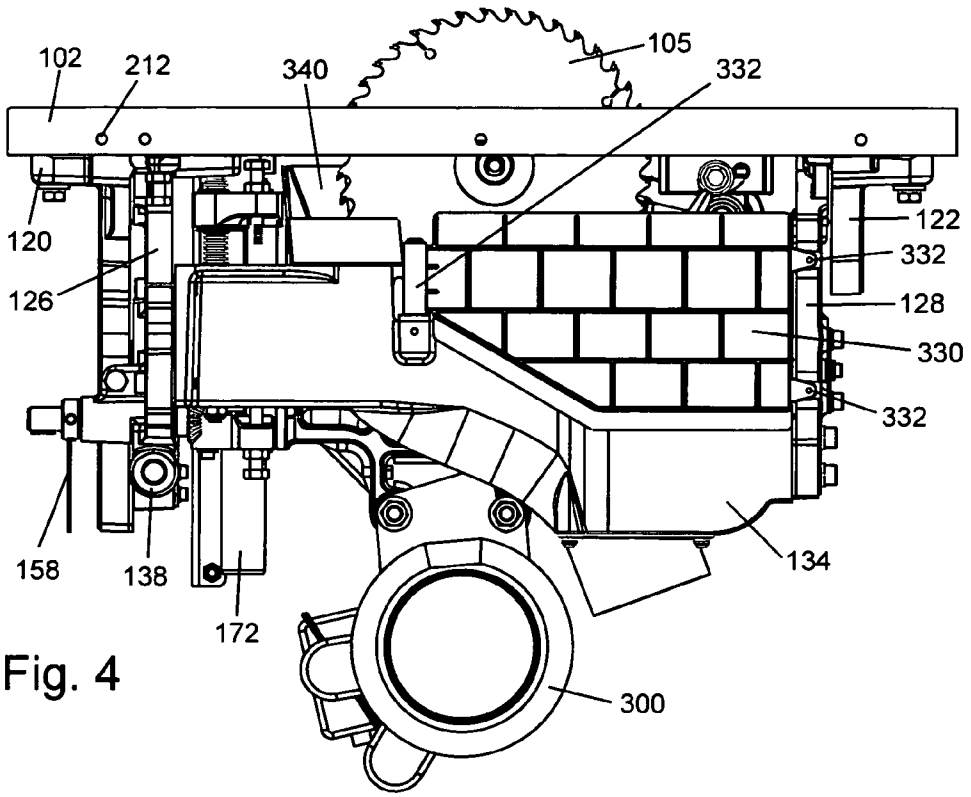
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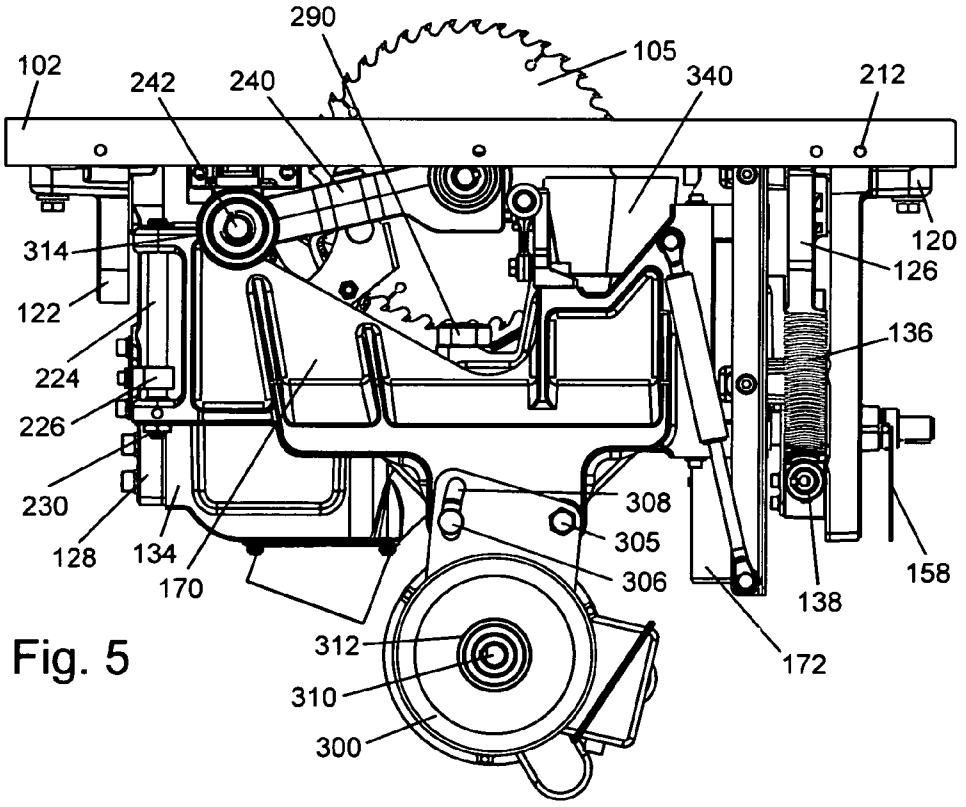
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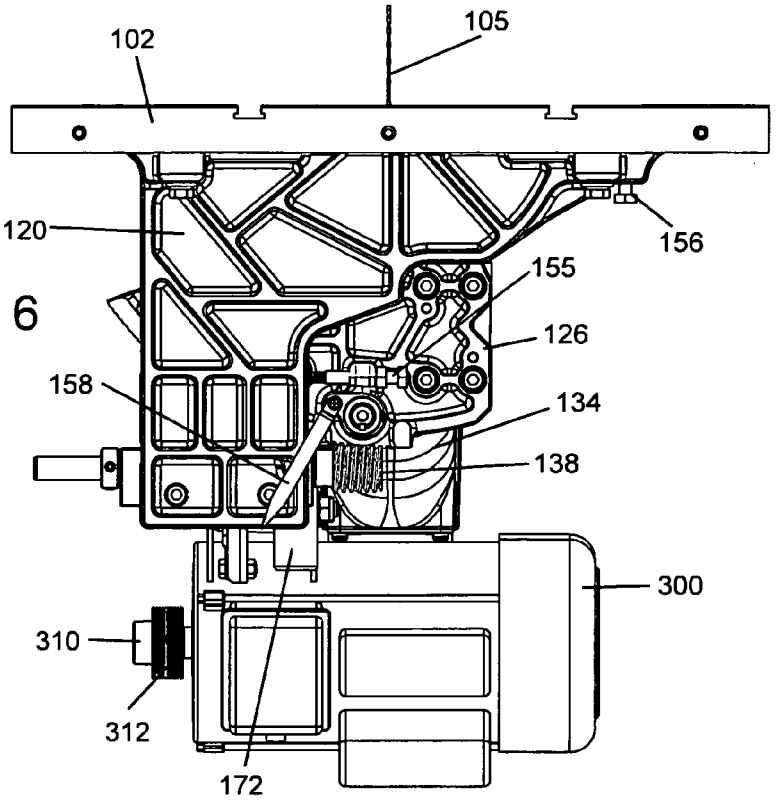
Fig. 5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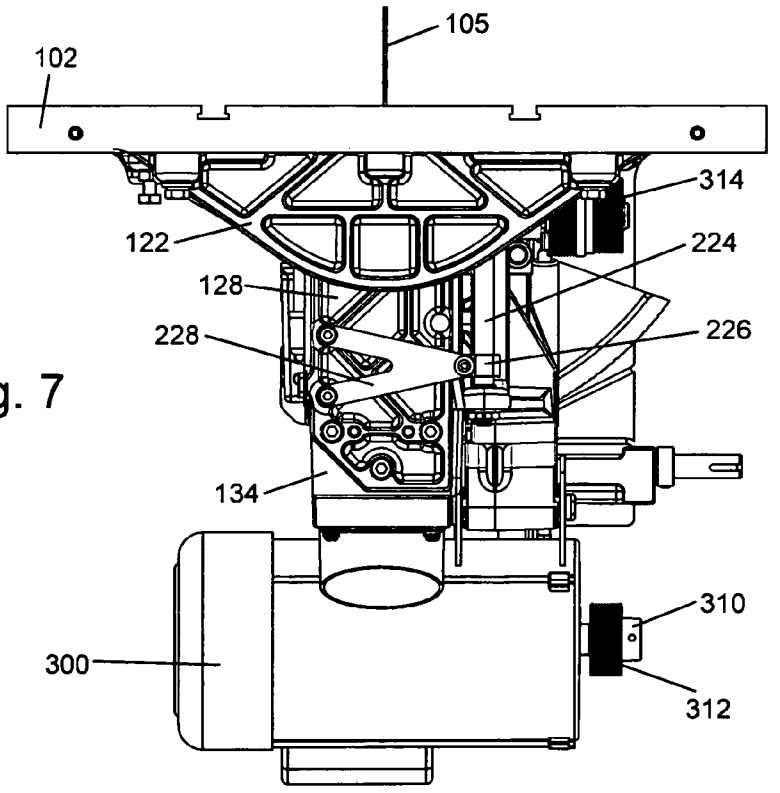
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Fig. 7

Fig. 8

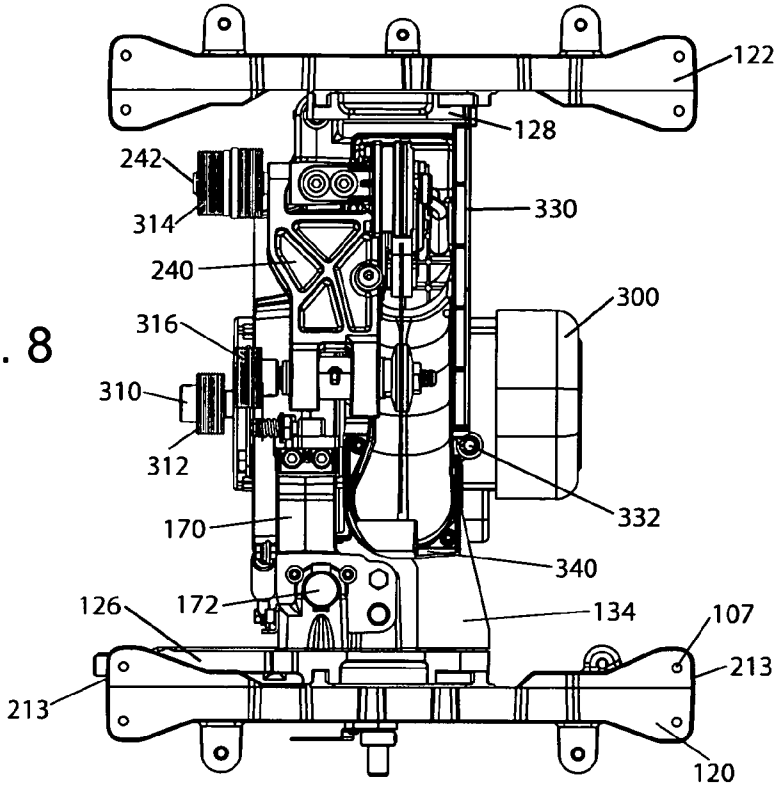
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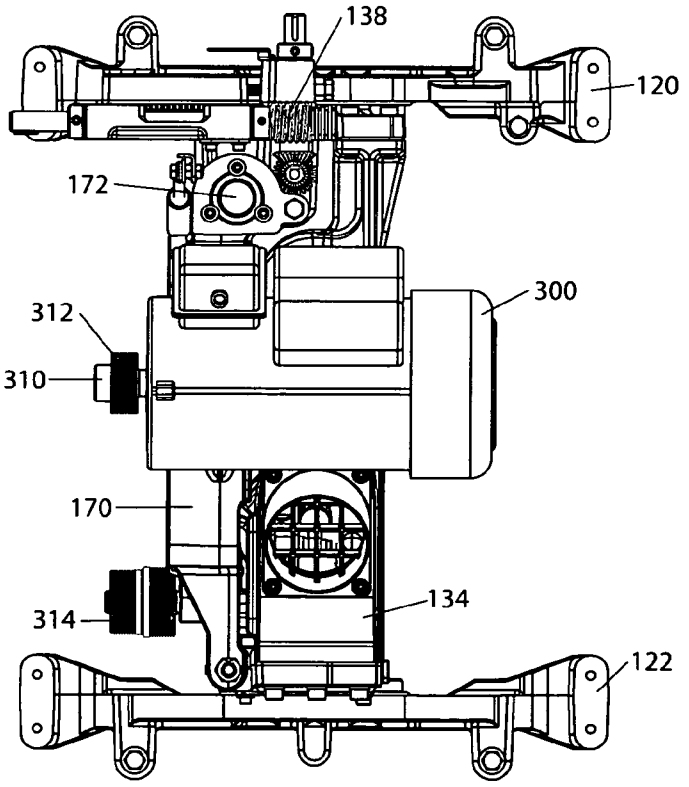
Fig. 9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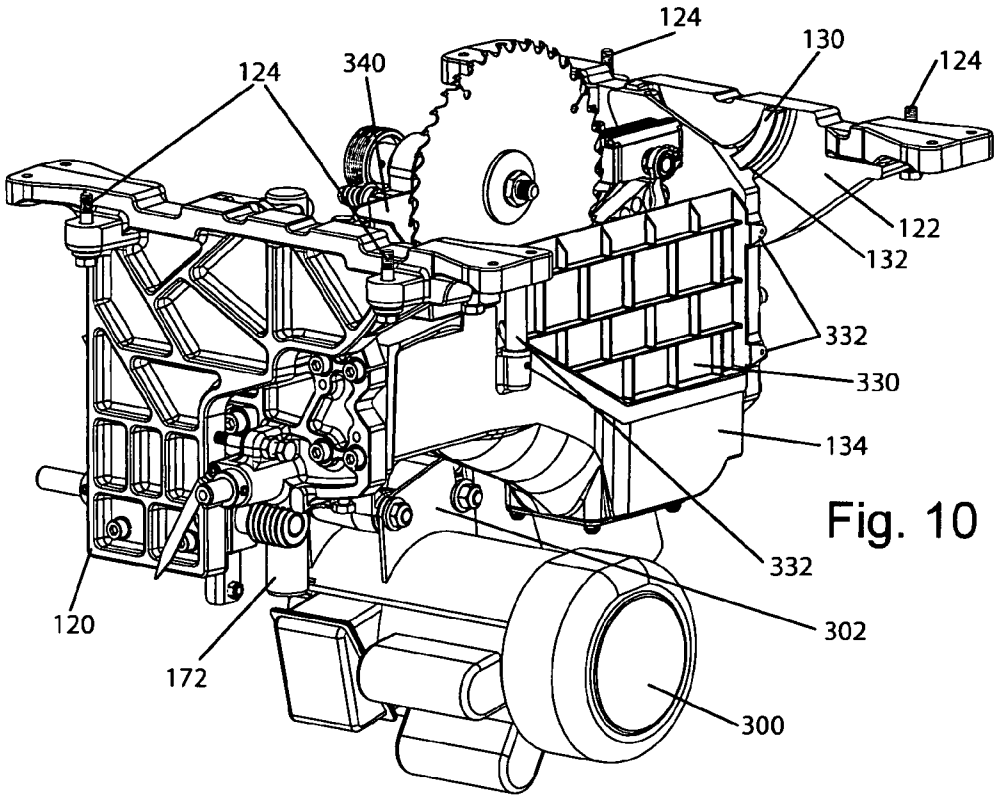
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Fig. 10

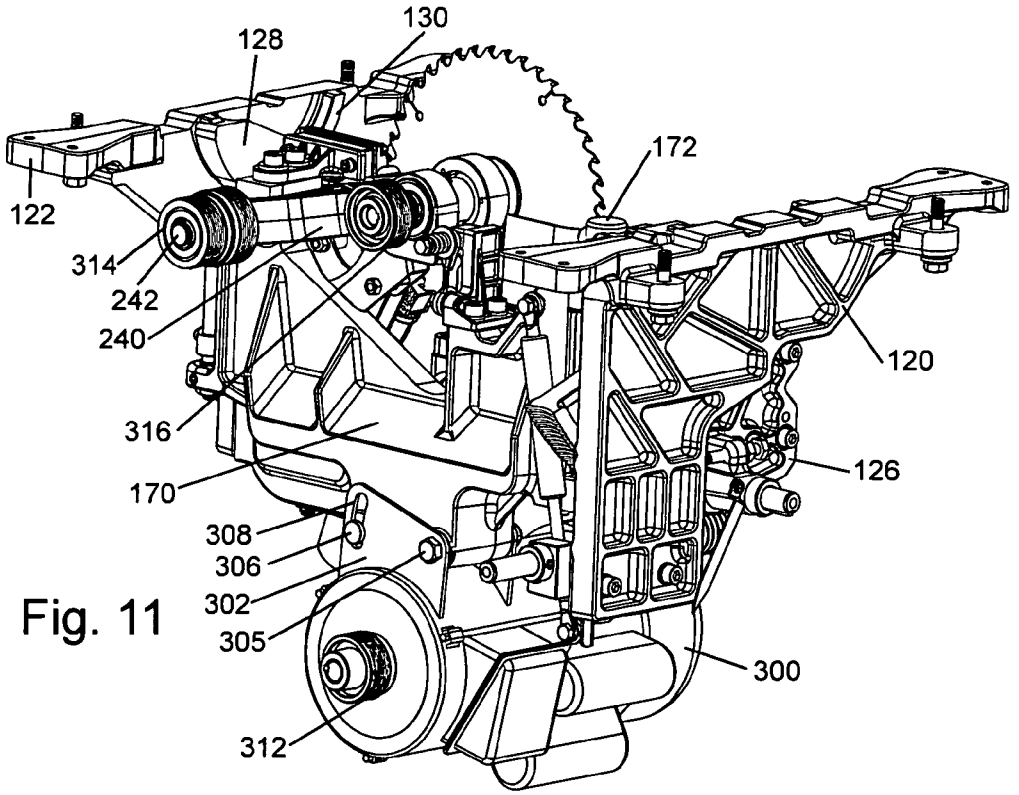
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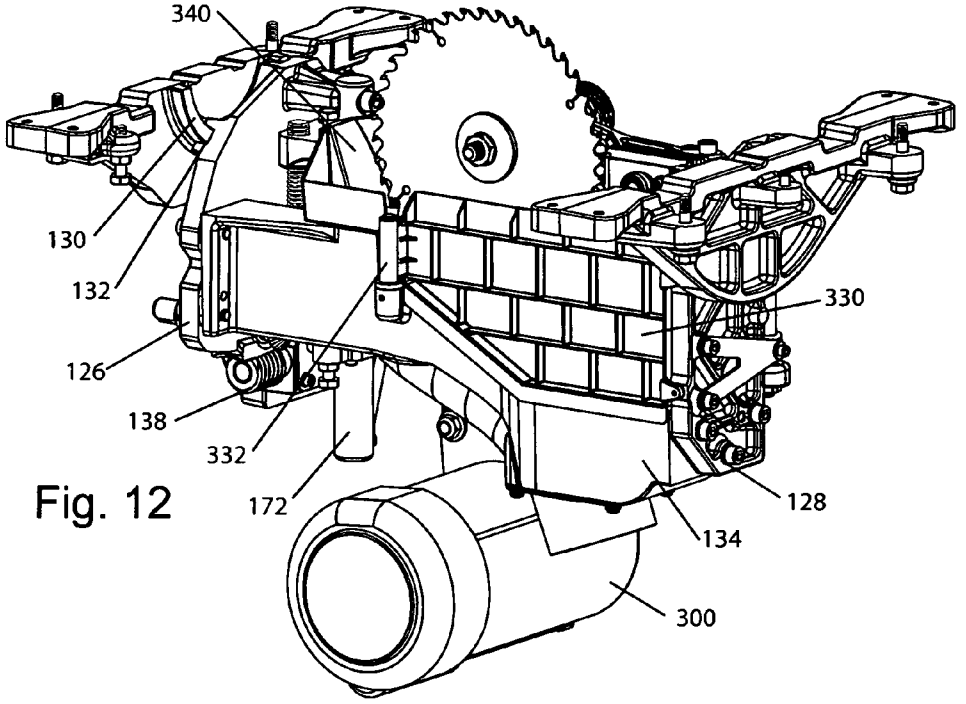
Fig. 11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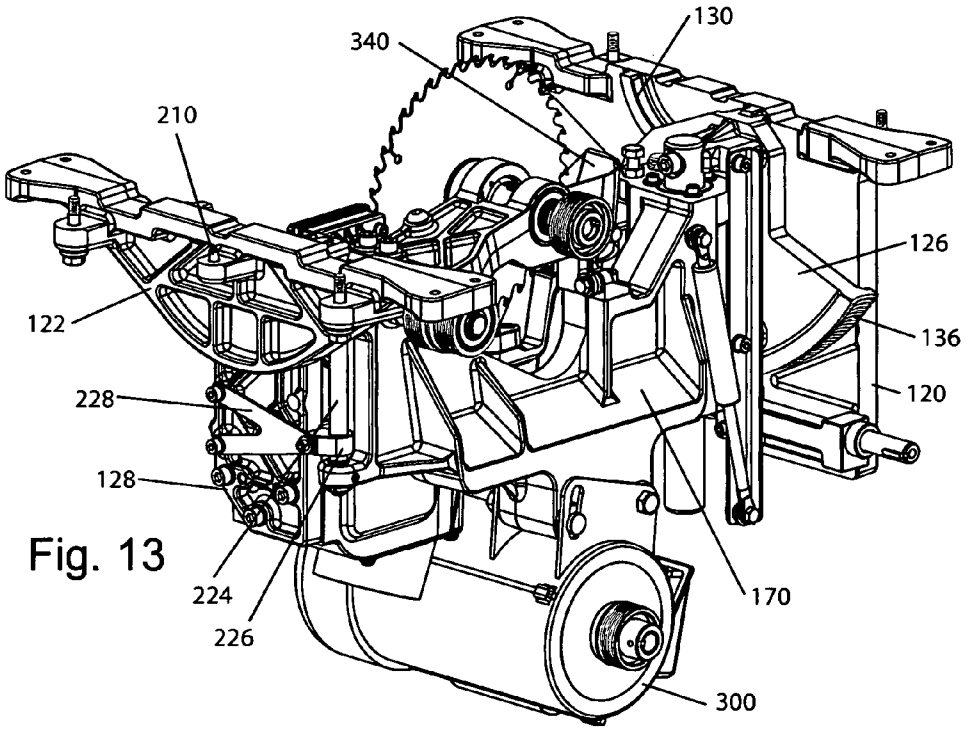
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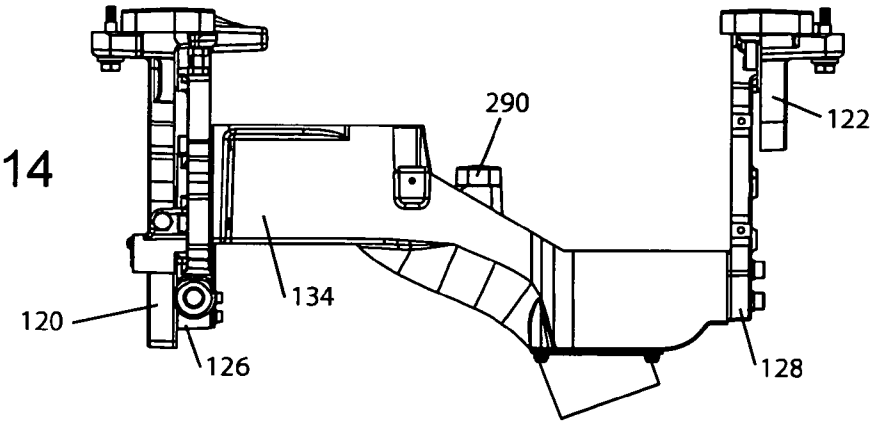
Fig. 13

Fig. 14

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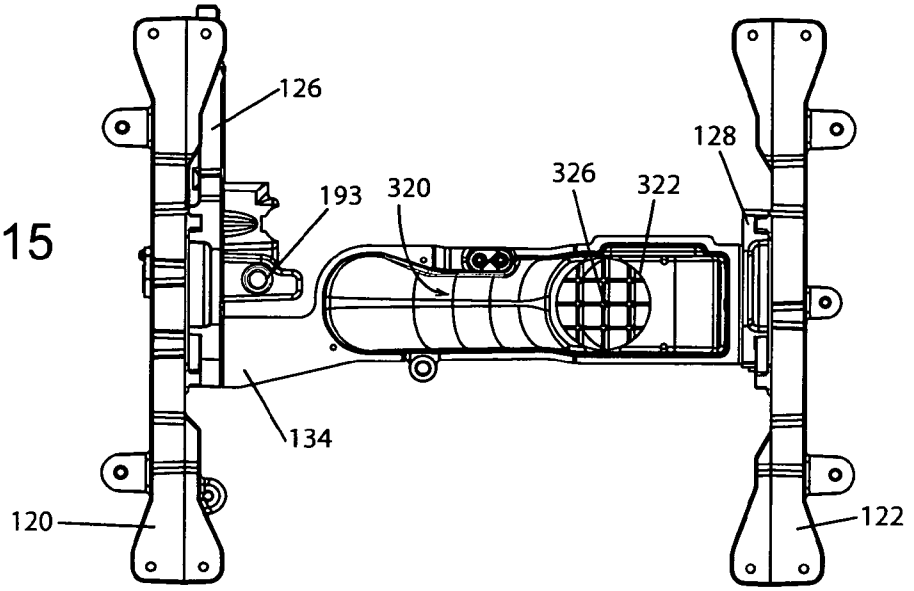
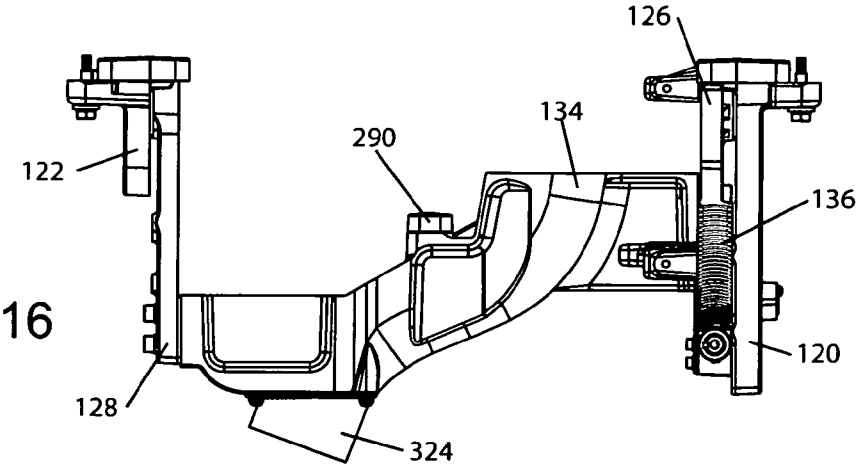



Fig. 16



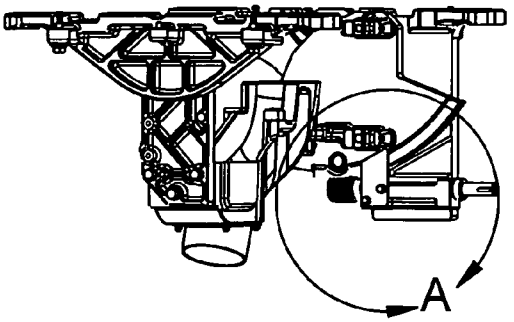



Fig. 17

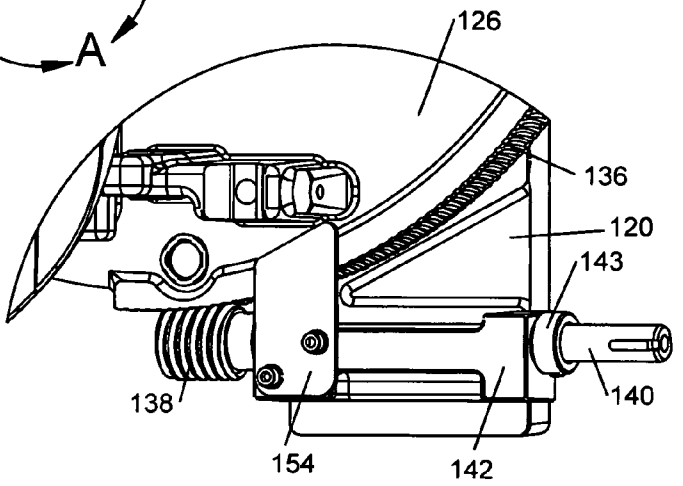



Fig. 18
Detail A

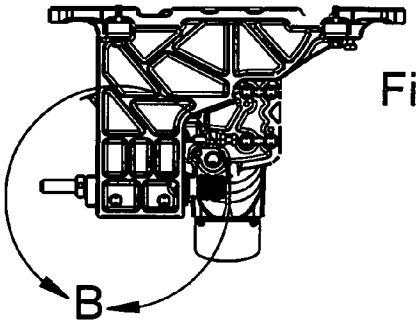



Fig. 19

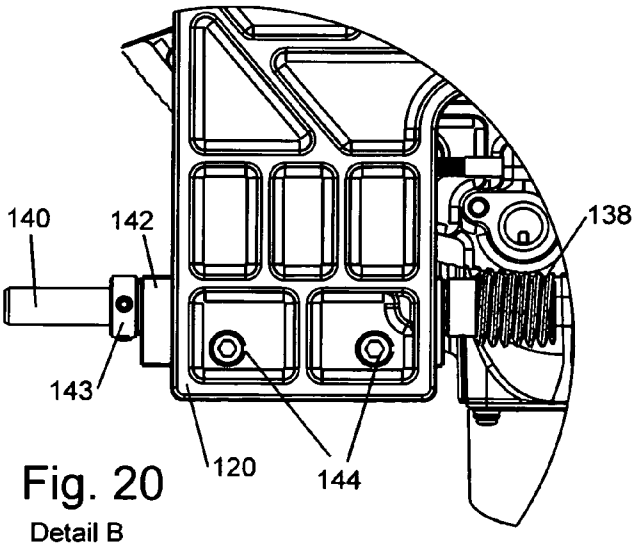



Fig. 20
Detail B

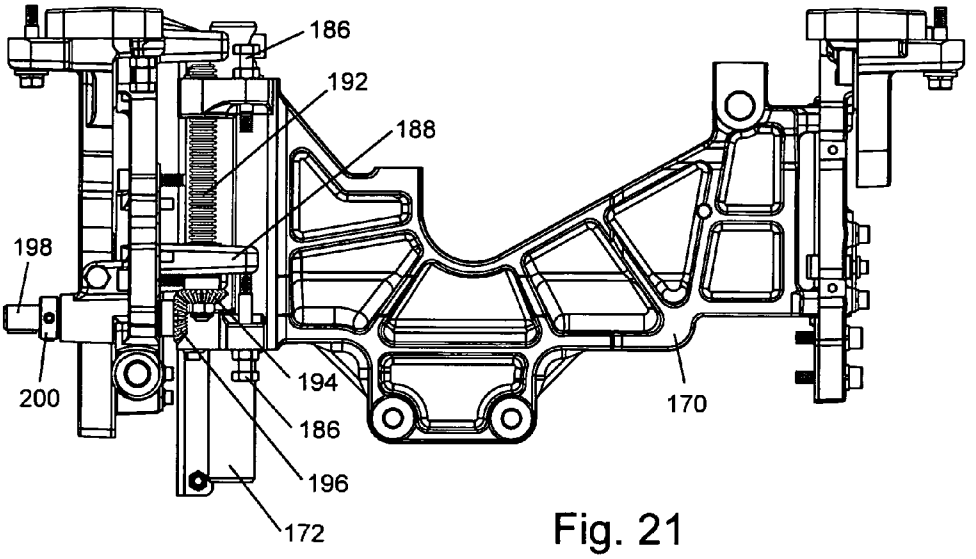

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Fig. 21

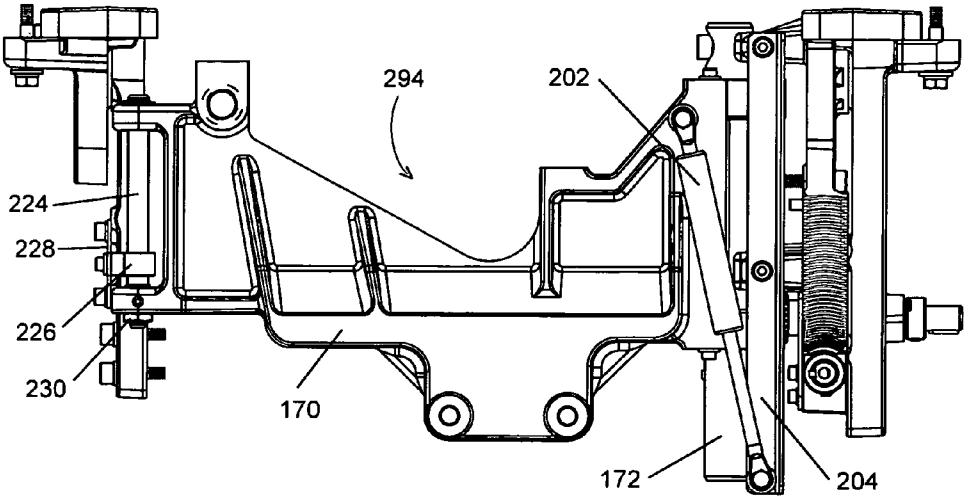
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Fig. 22

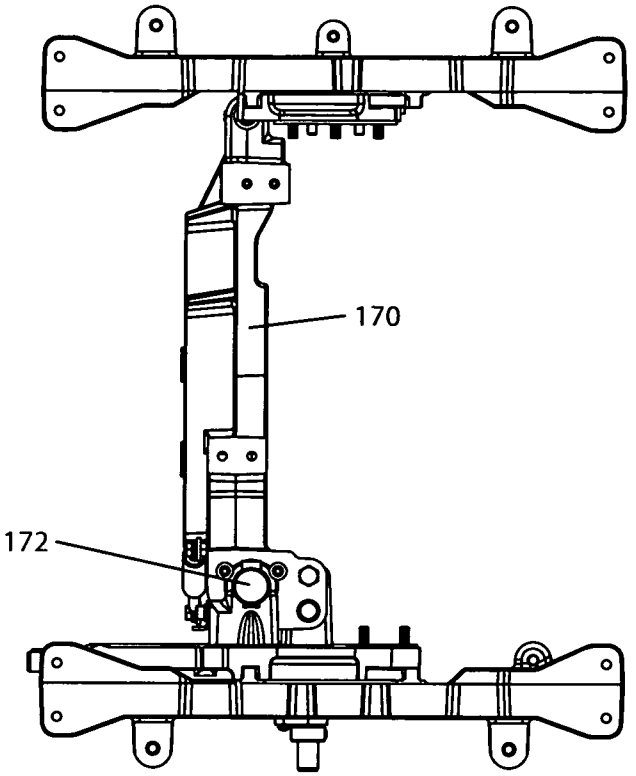



Fig. 23

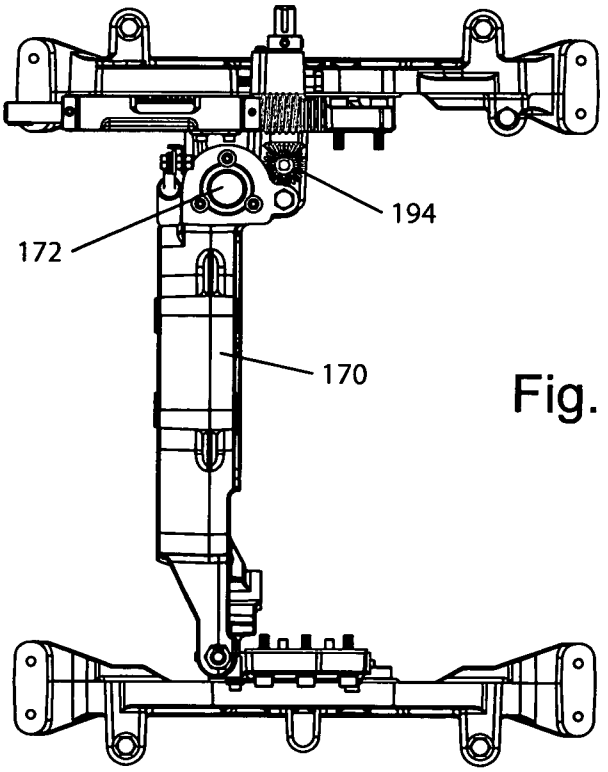
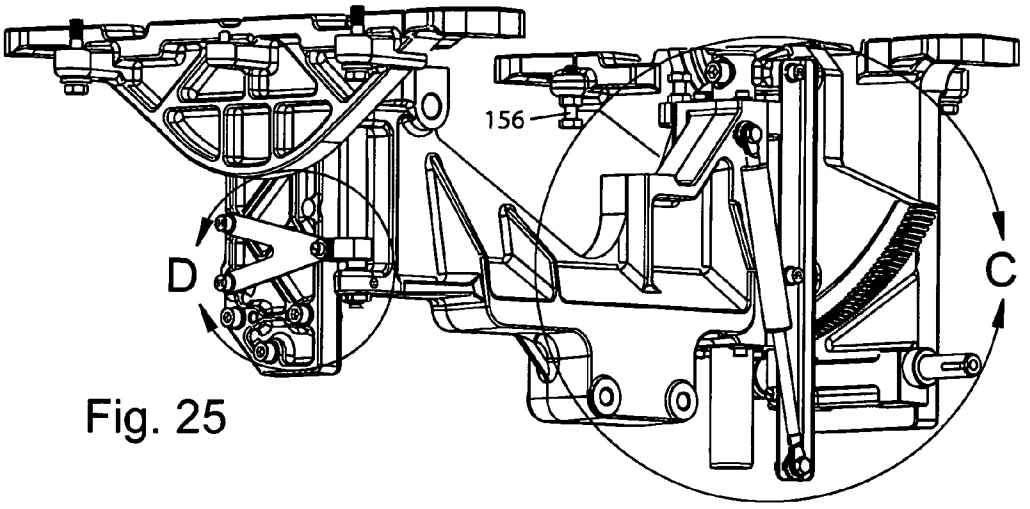



Fig. 24

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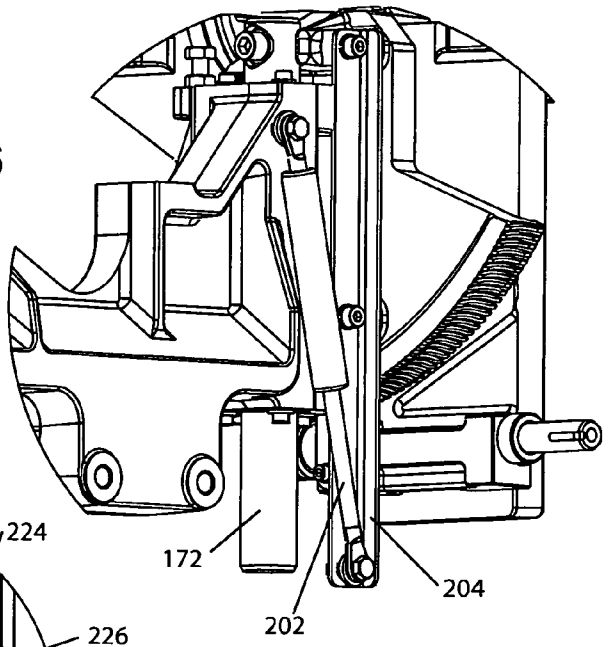


Fig. 26
Detail C

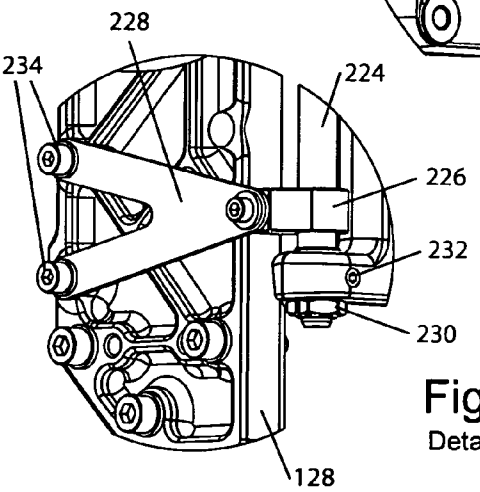


Fig. 27
Detail D

Fig. 28

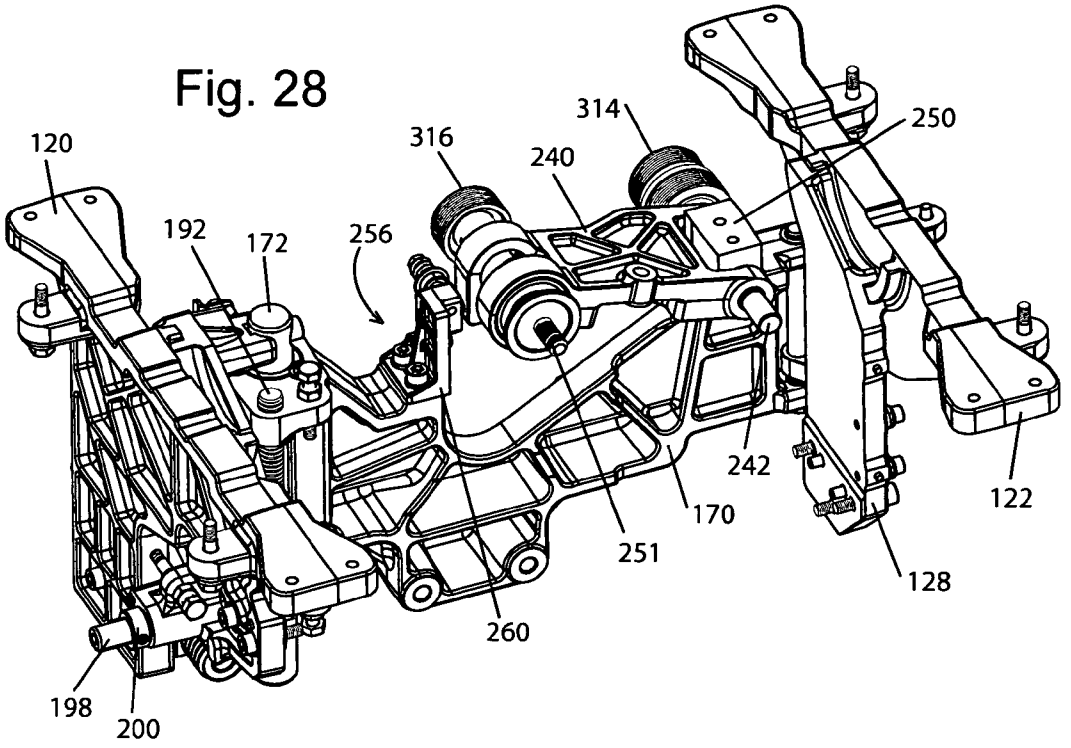
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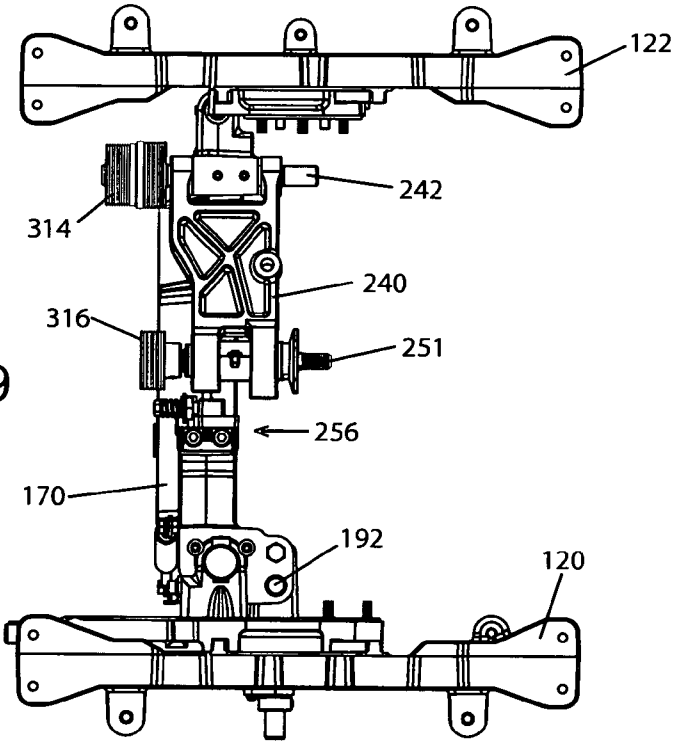
Fig. 29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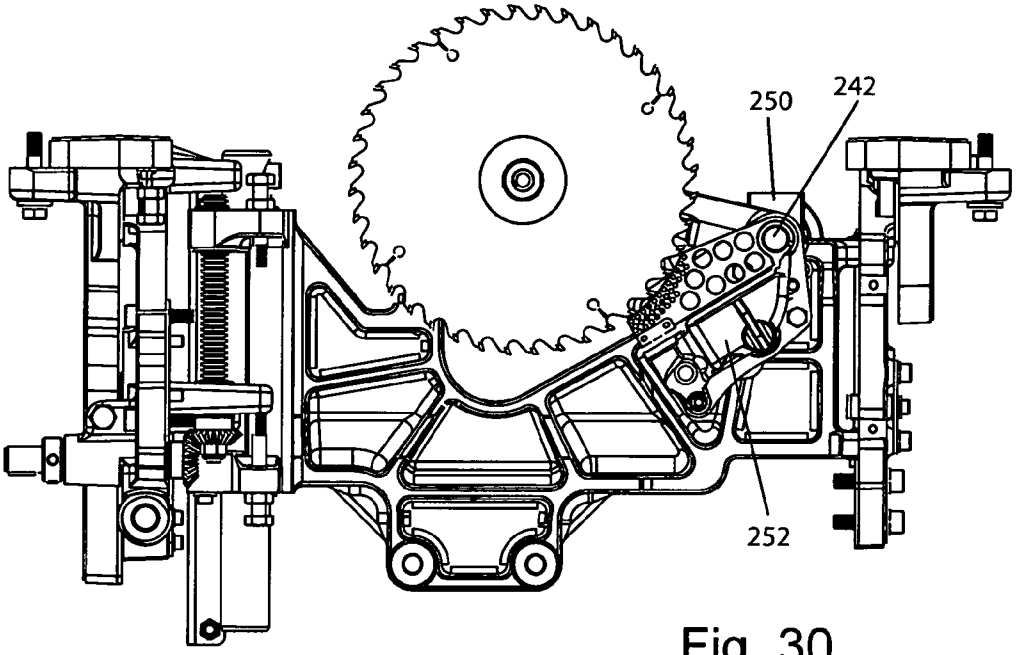



Fig. 30

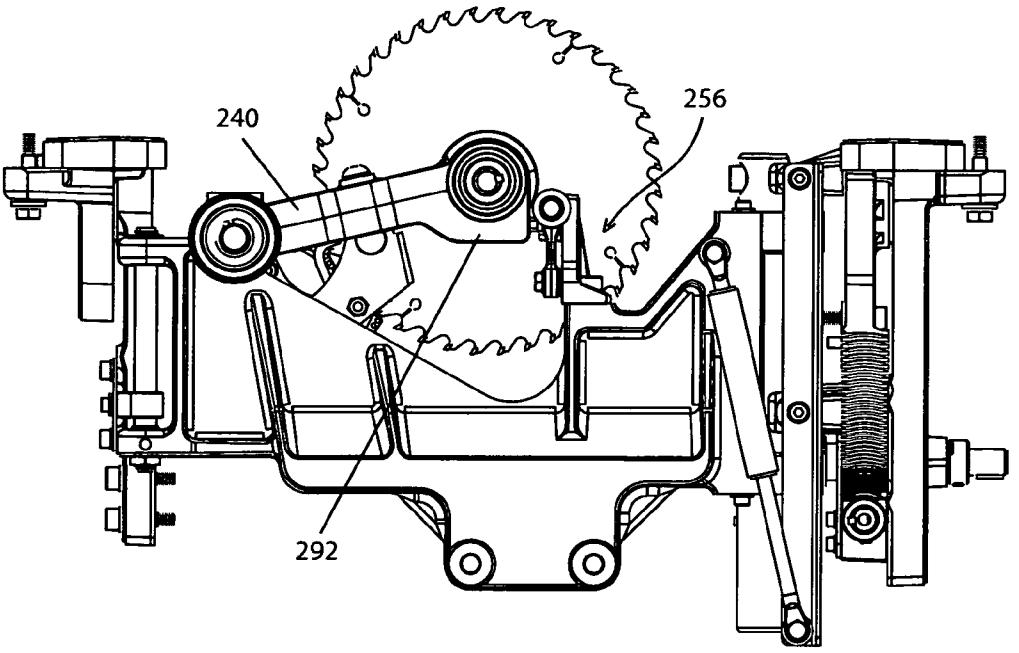
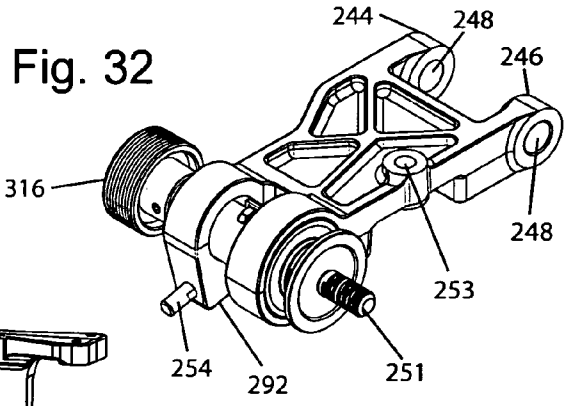



Fig. 31

Fig. 32



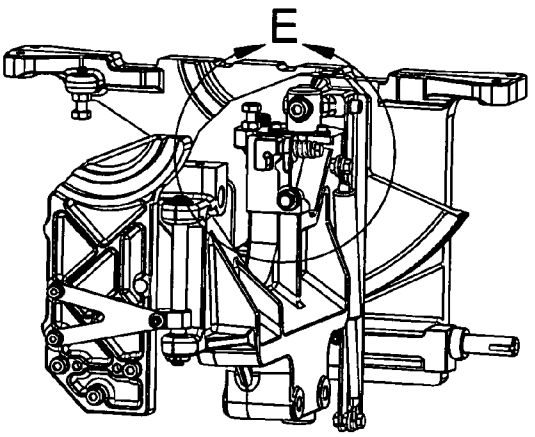
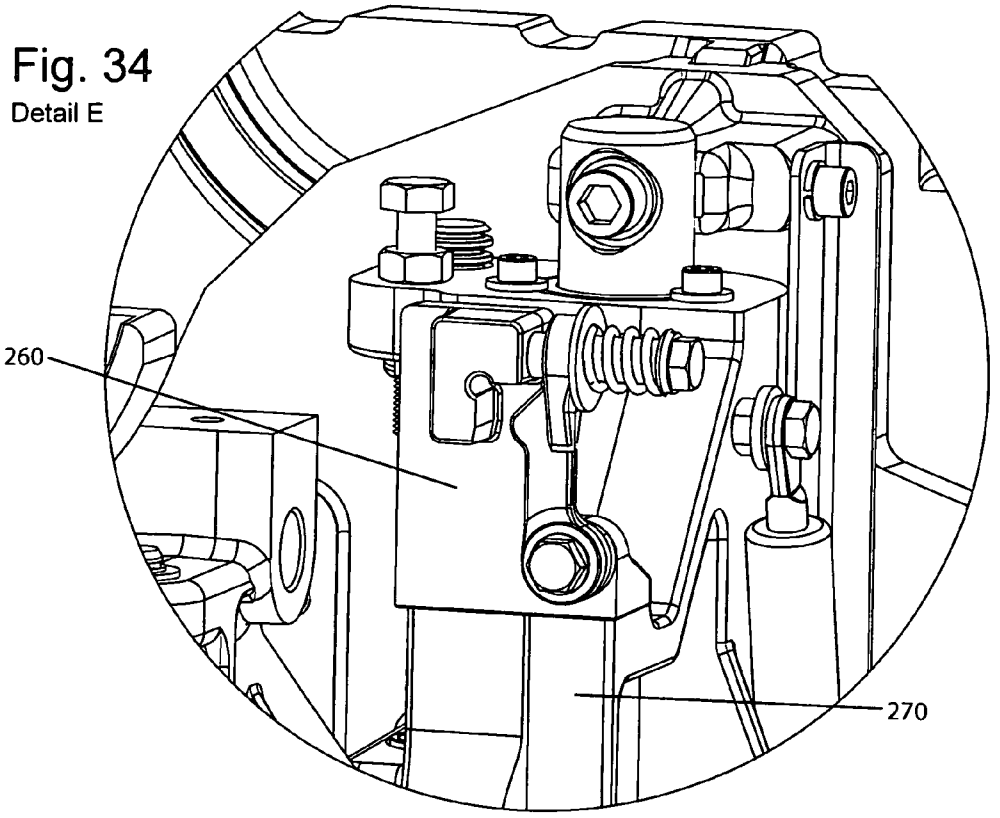




Fig. 33

Fig. 34
Detail E



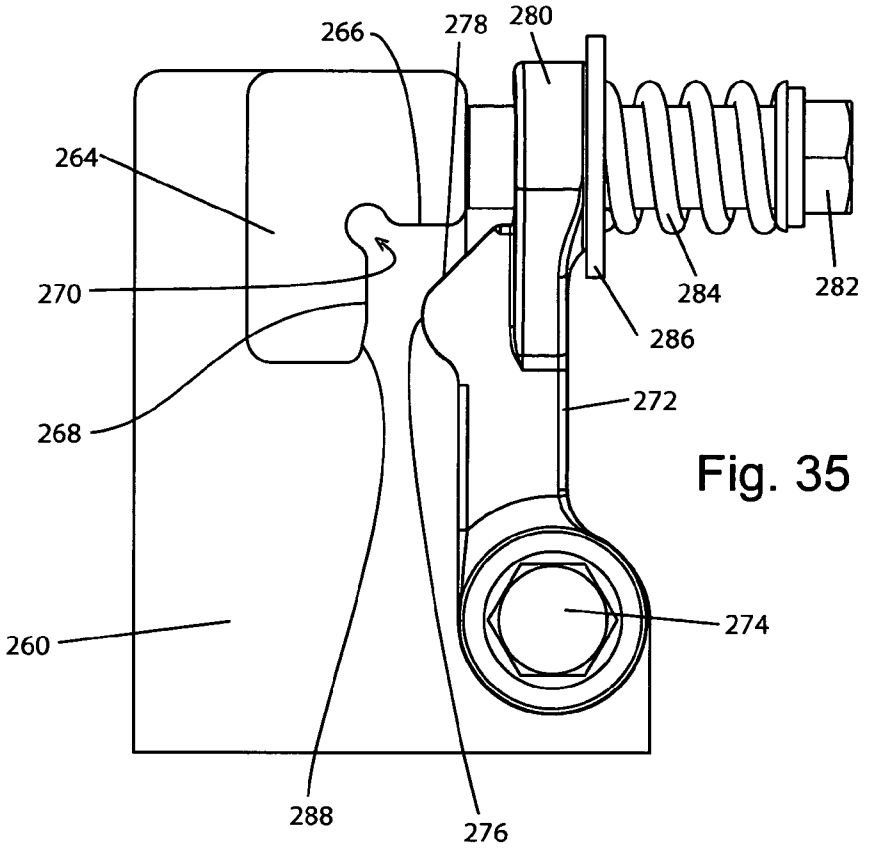

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Fig. 35

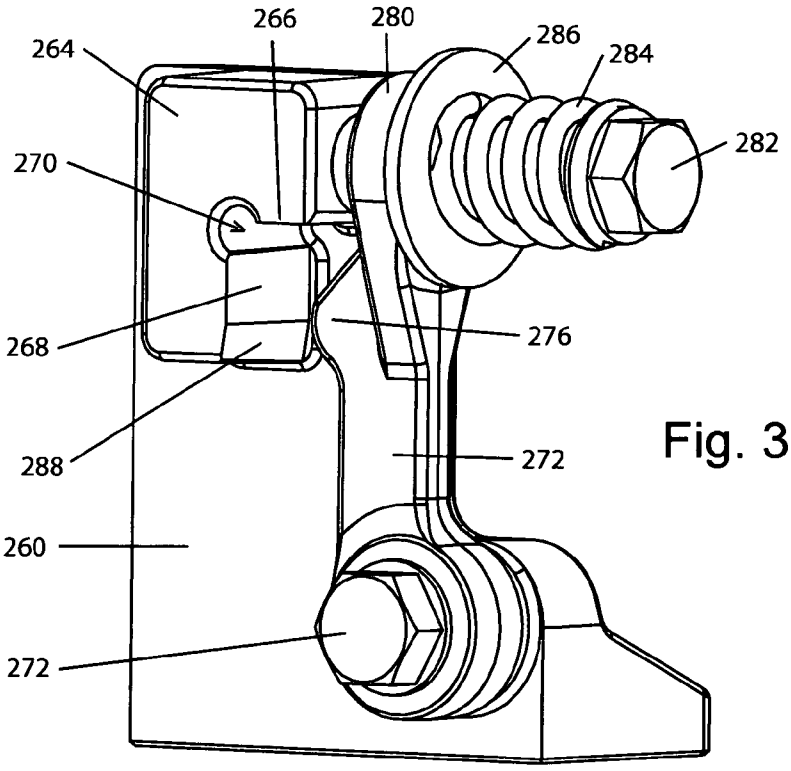
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Fig. 36

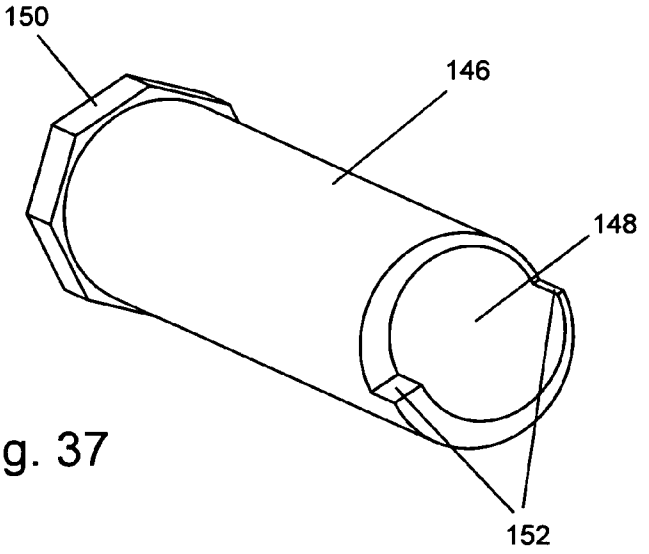


Fig. 37

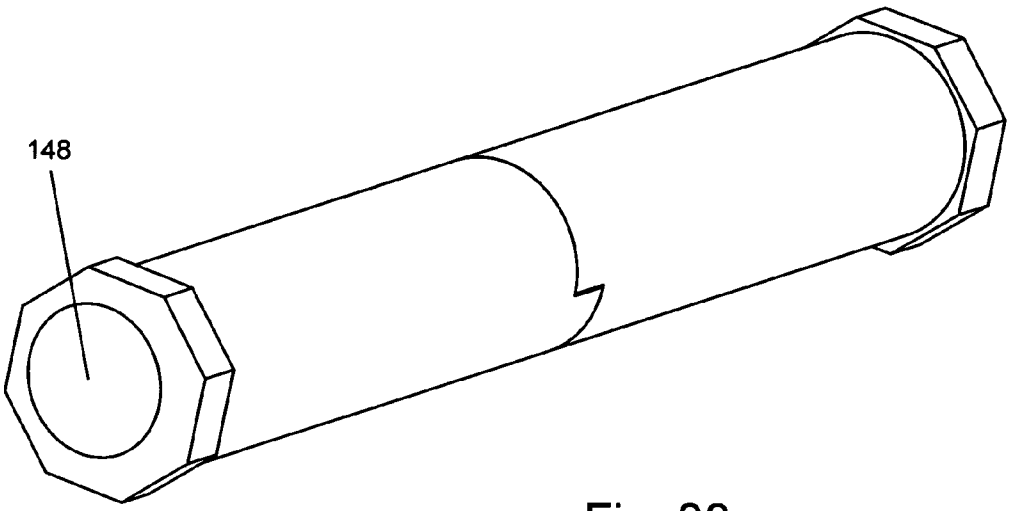


Fig. 38

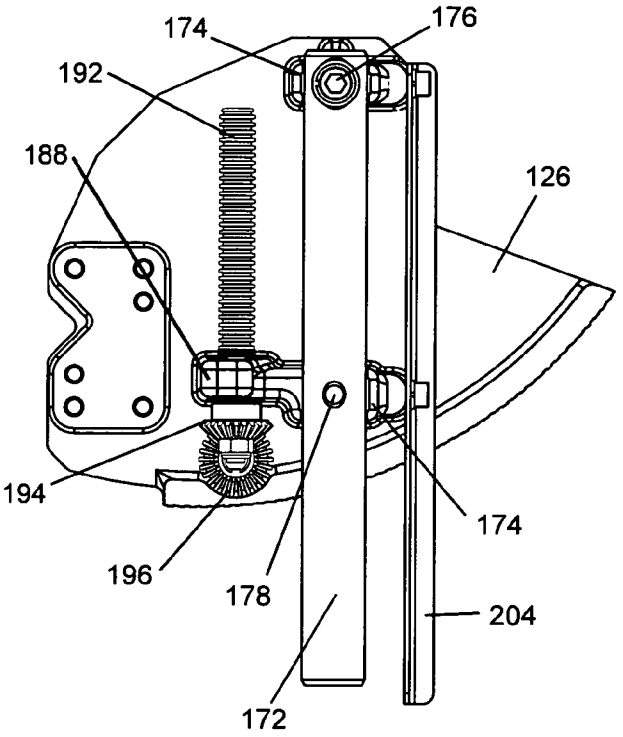


Fig. 39

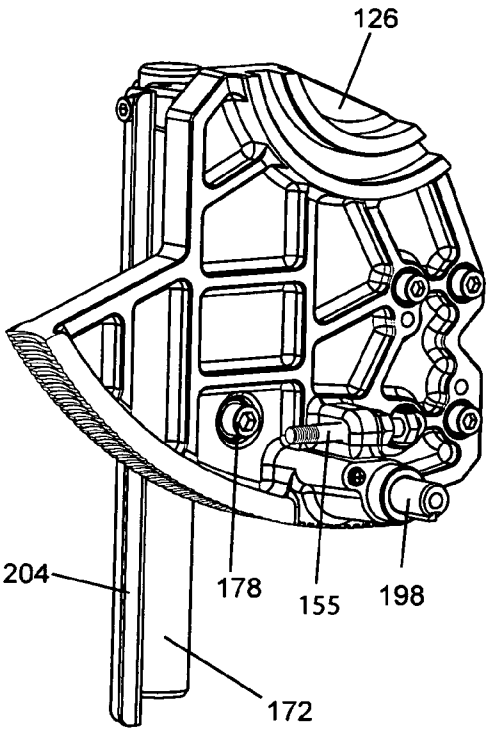


Fig. 40

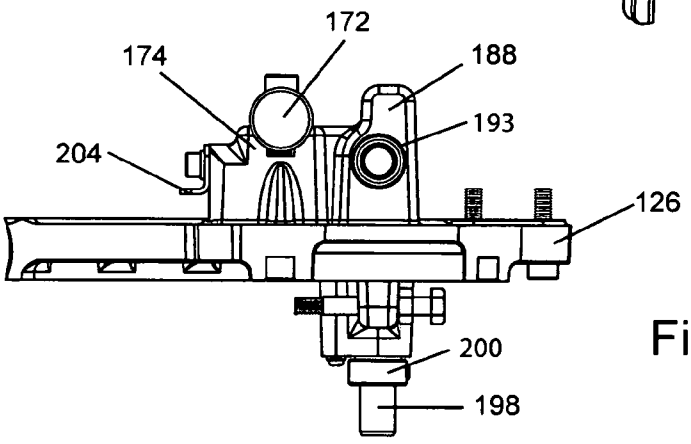


Fig. 41

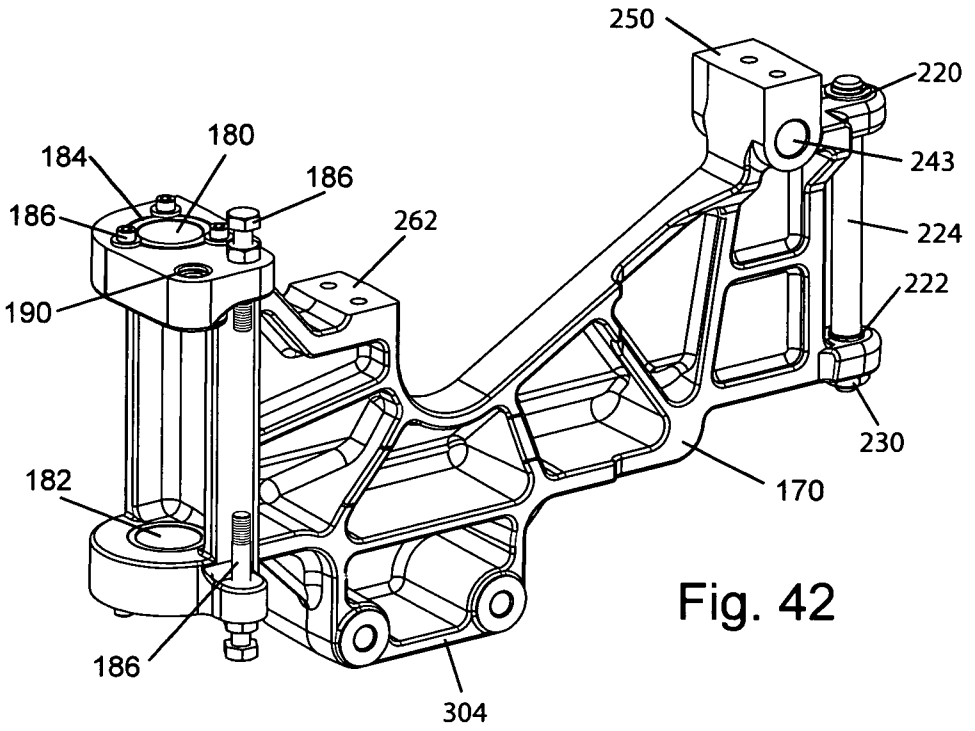
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Fig. 42

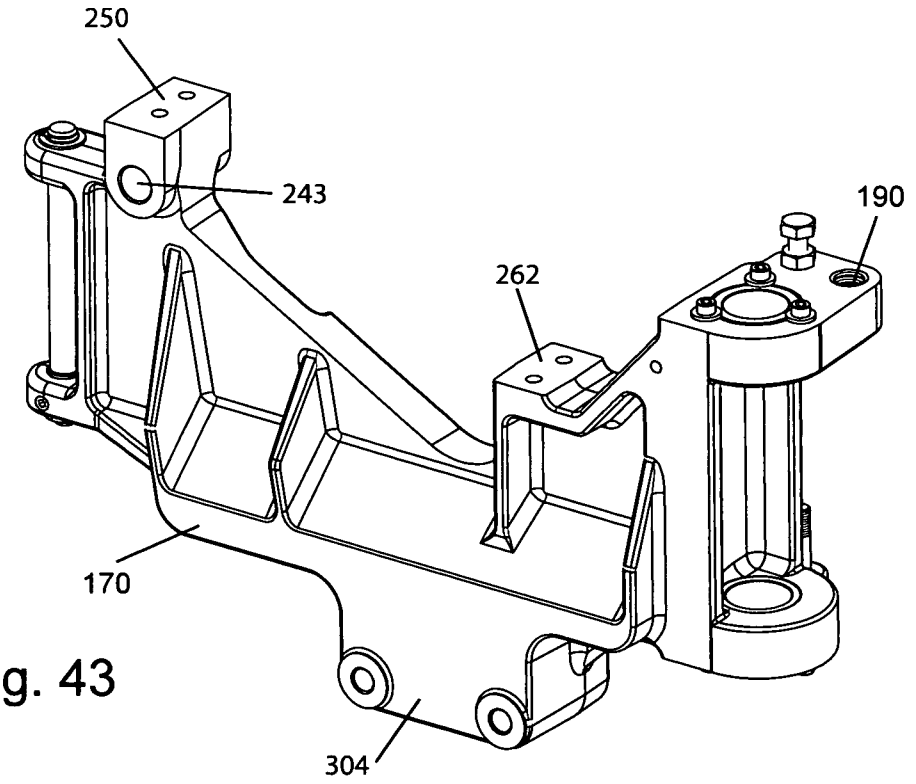
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Fig. 43

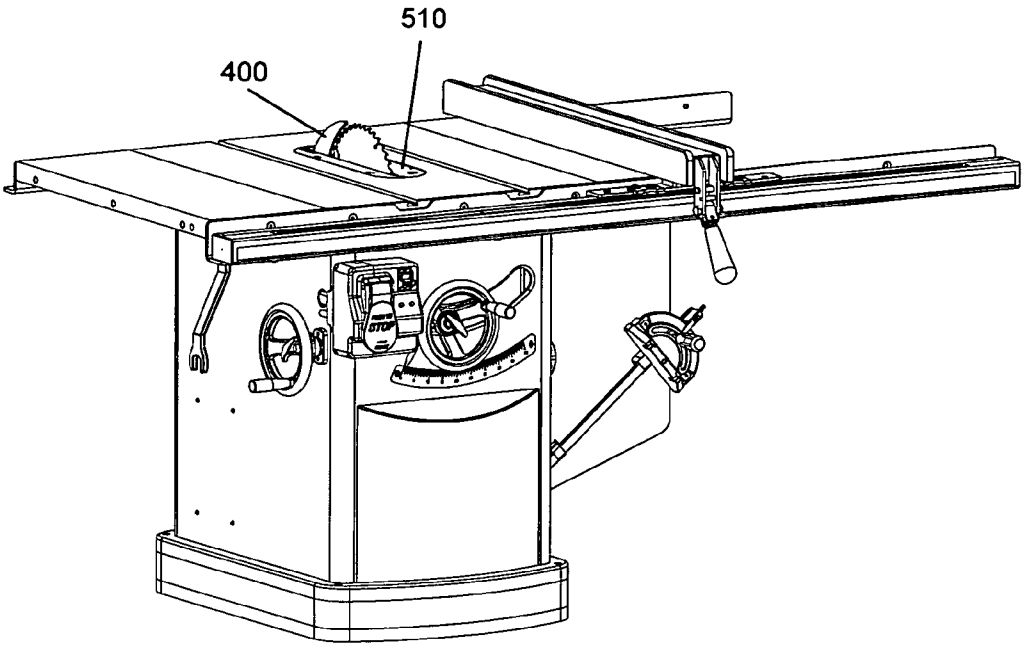


Fig. 44

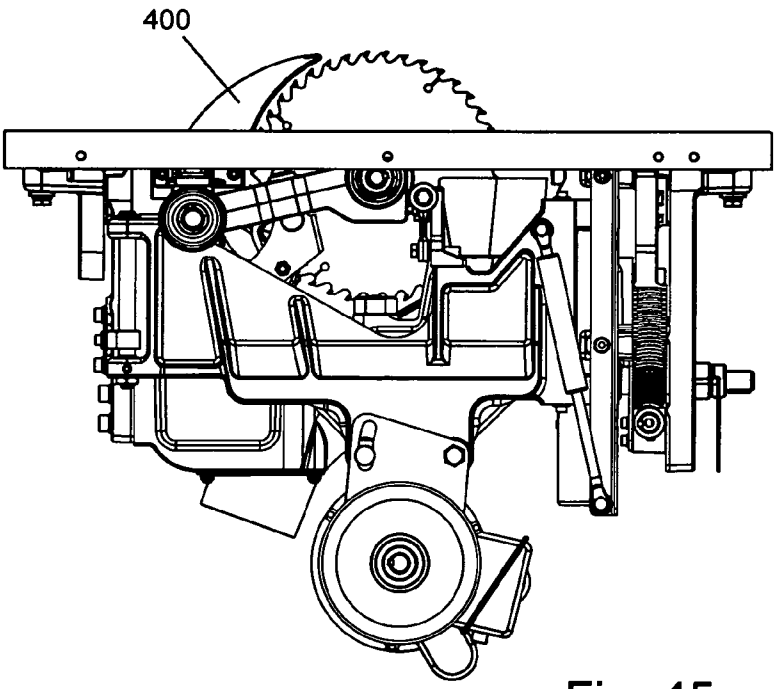


Fig. 45

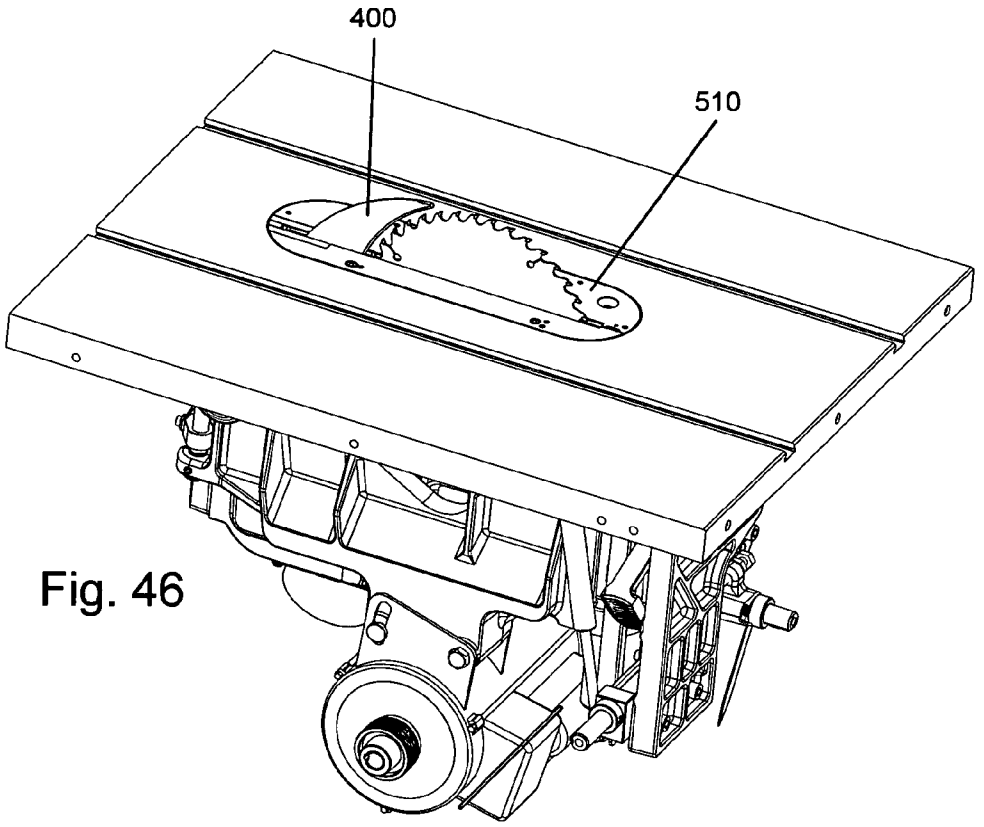


Fig. 46

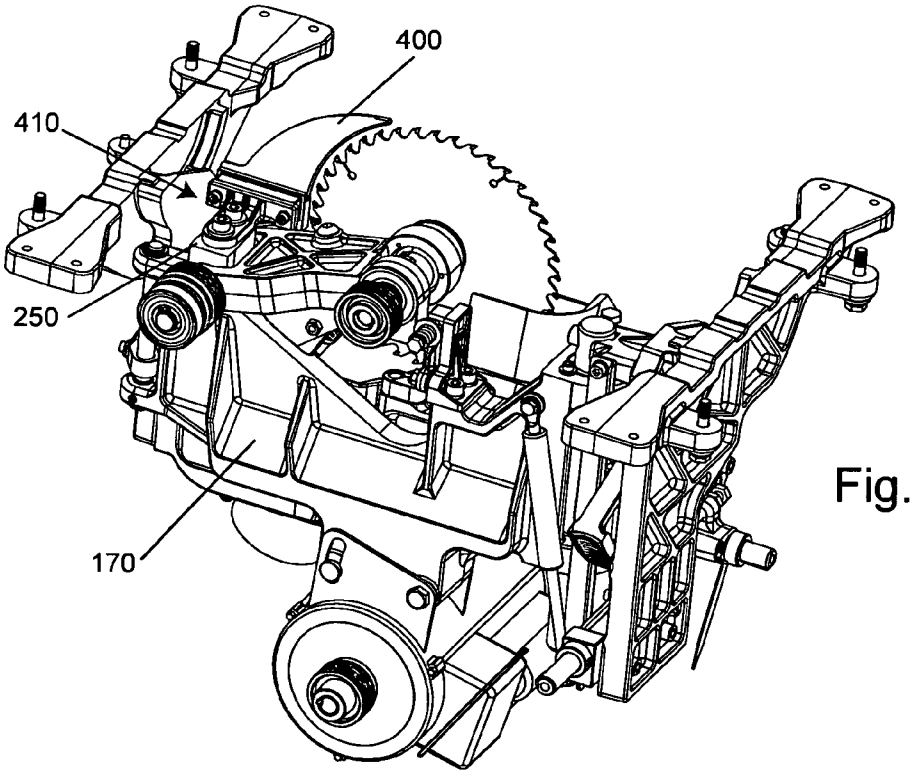


Fig. 47

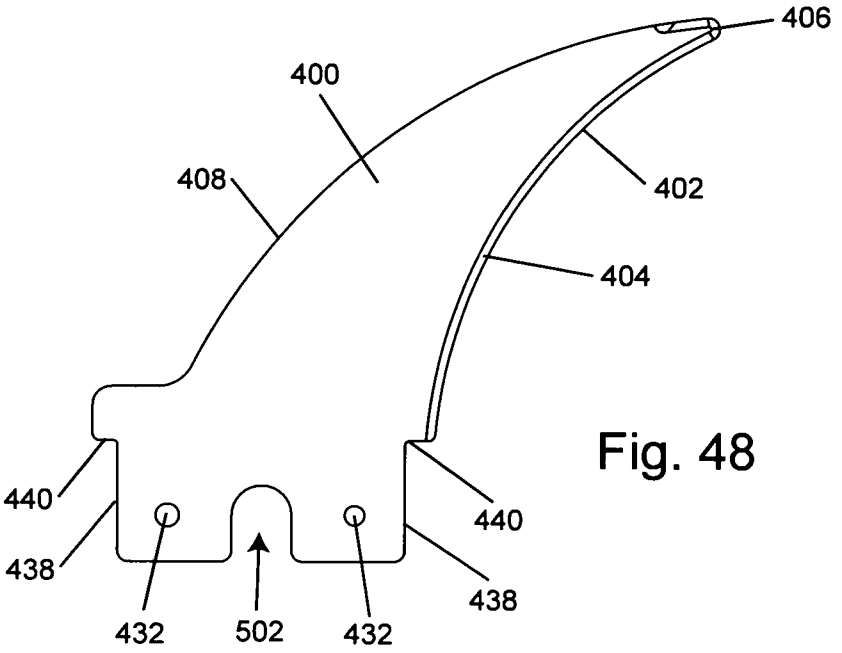
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Fig. 48

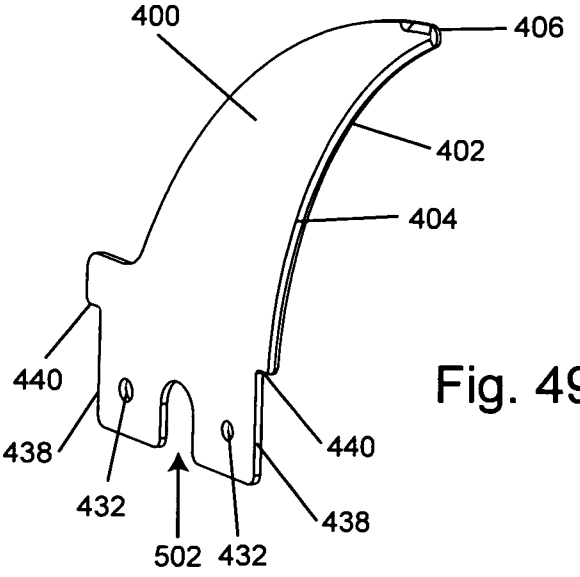
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Fig. 49

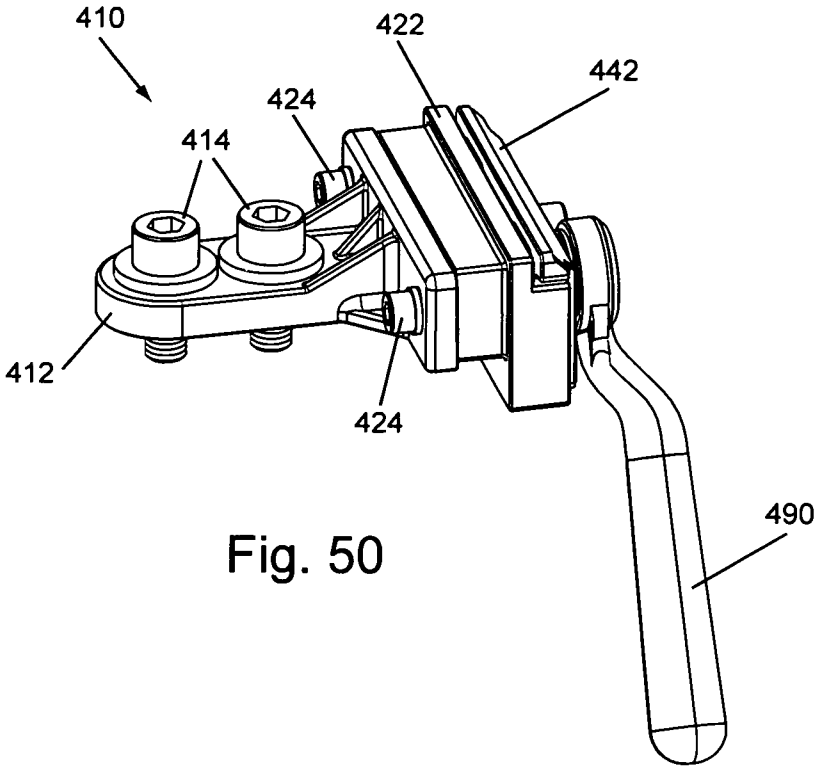
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Fig. 50

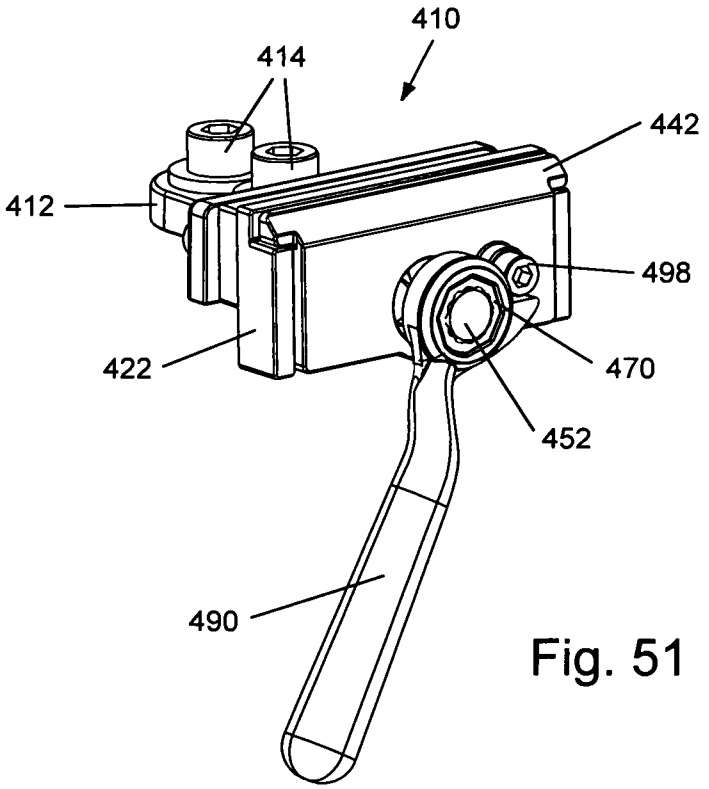
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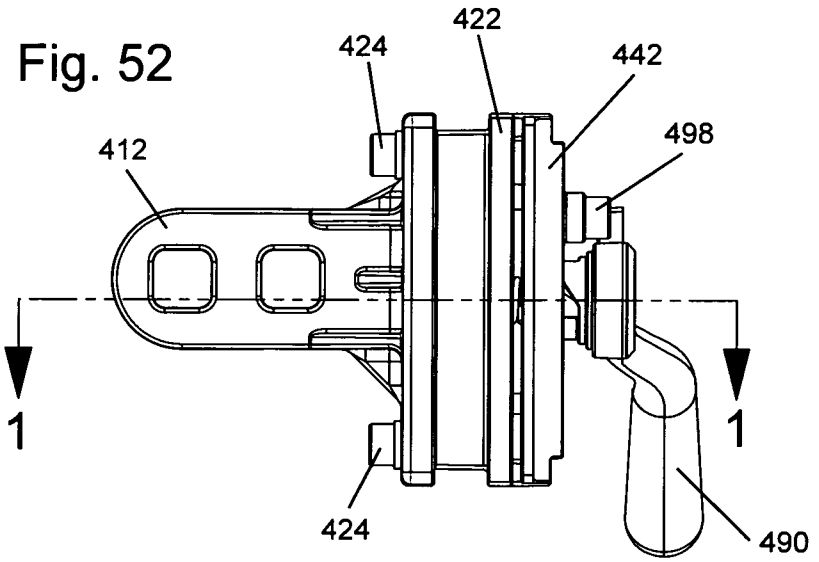
Fig. 51

Fig. 52



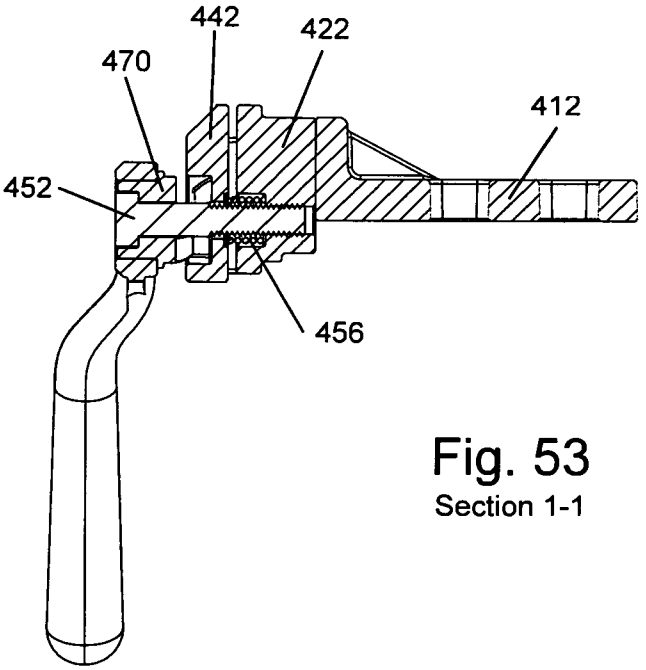




Fig. 53
Section 1-1

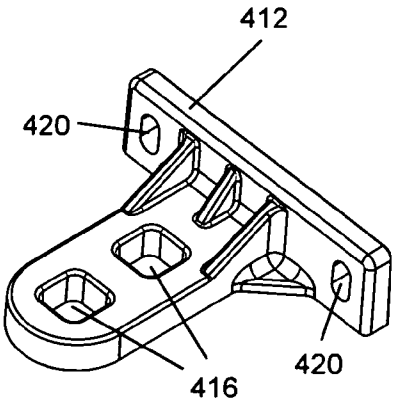



Fig. 54

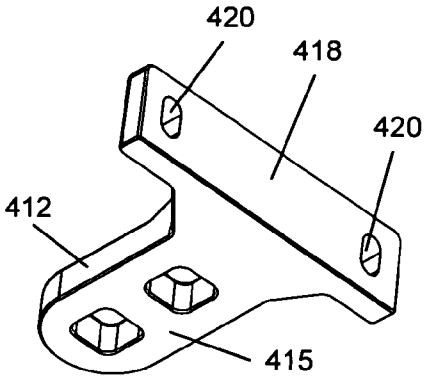



Fig. 55

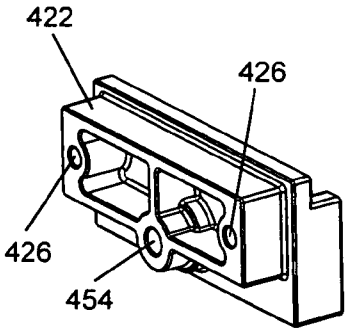



Fig. 56

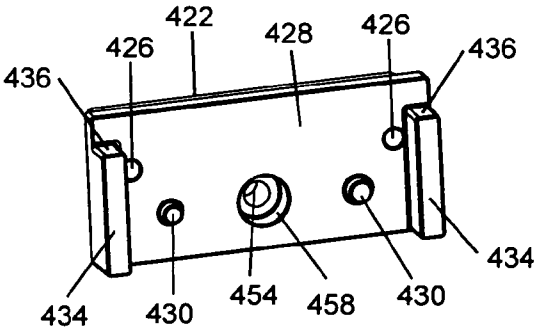



Fig. 57

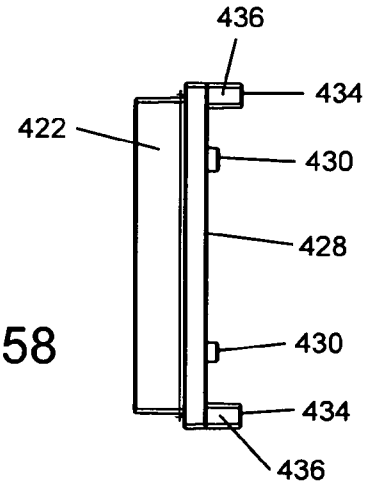
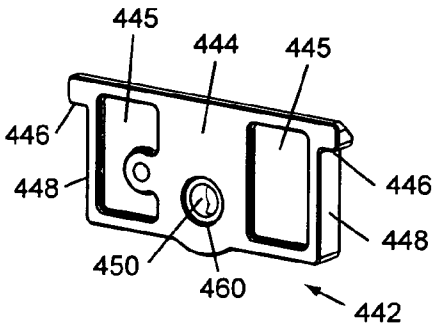



Fig. 58

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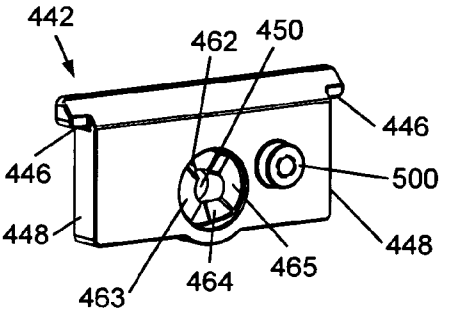


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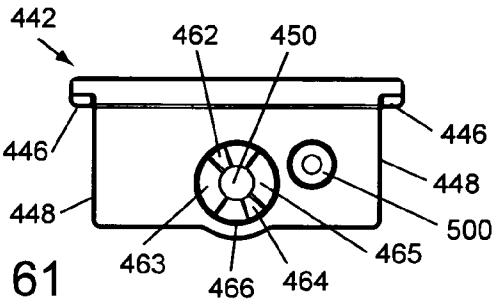


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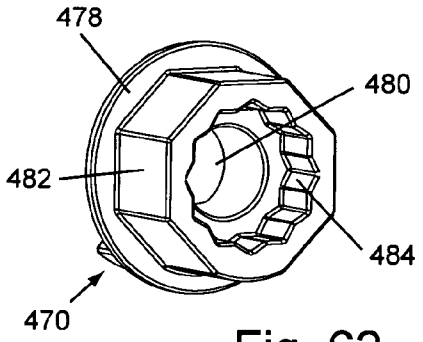


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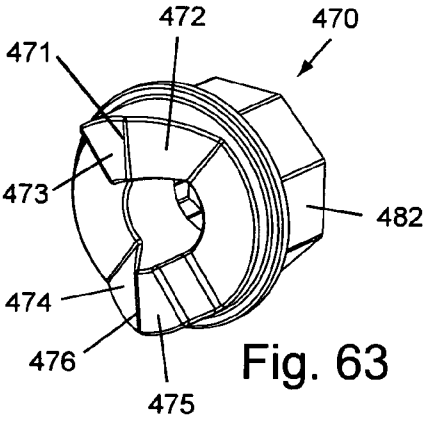


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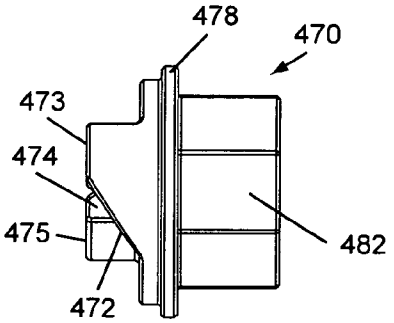


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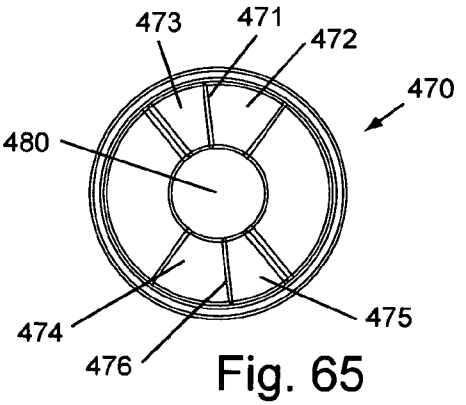


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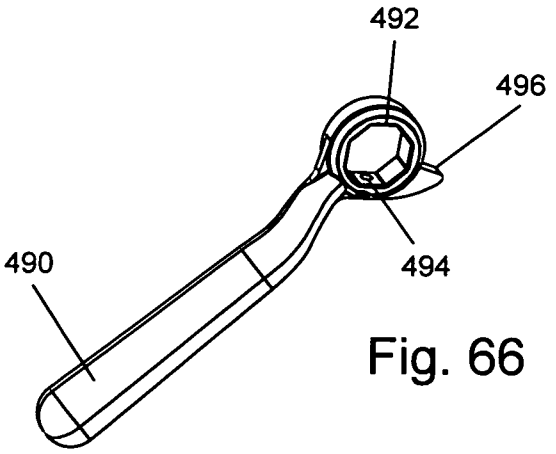


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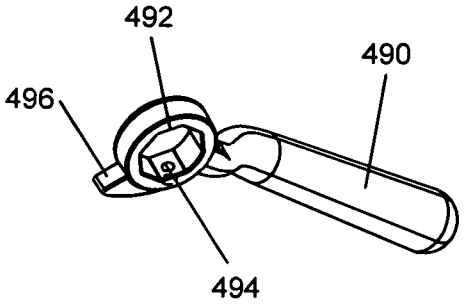


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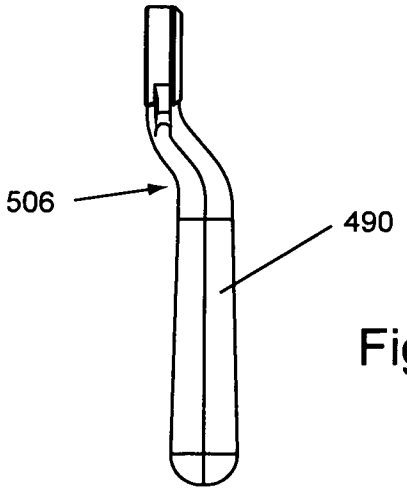


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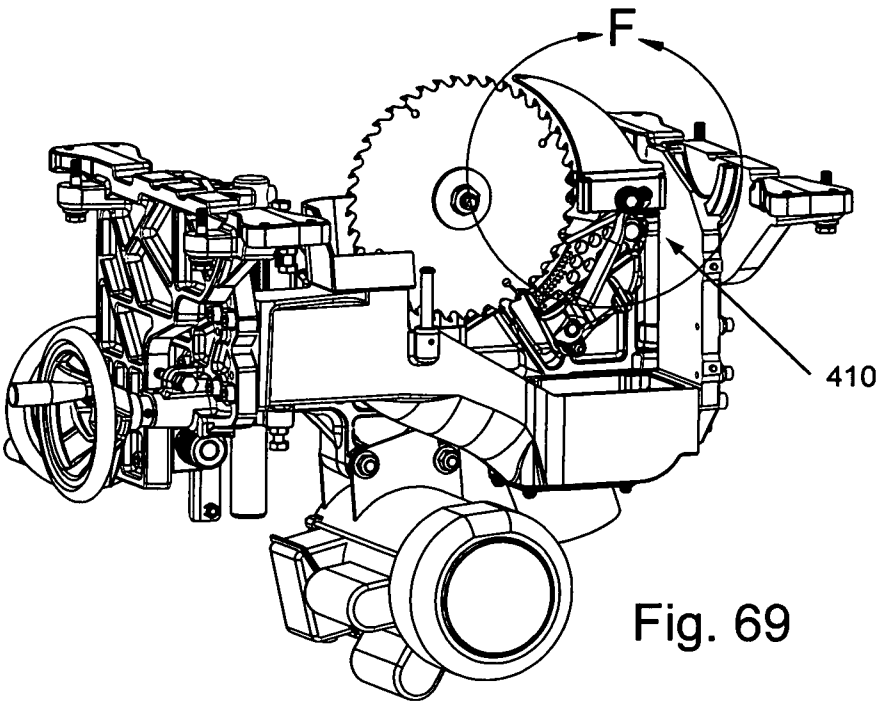


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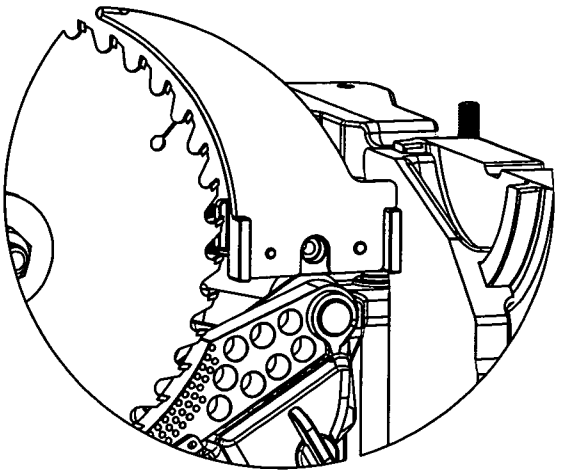
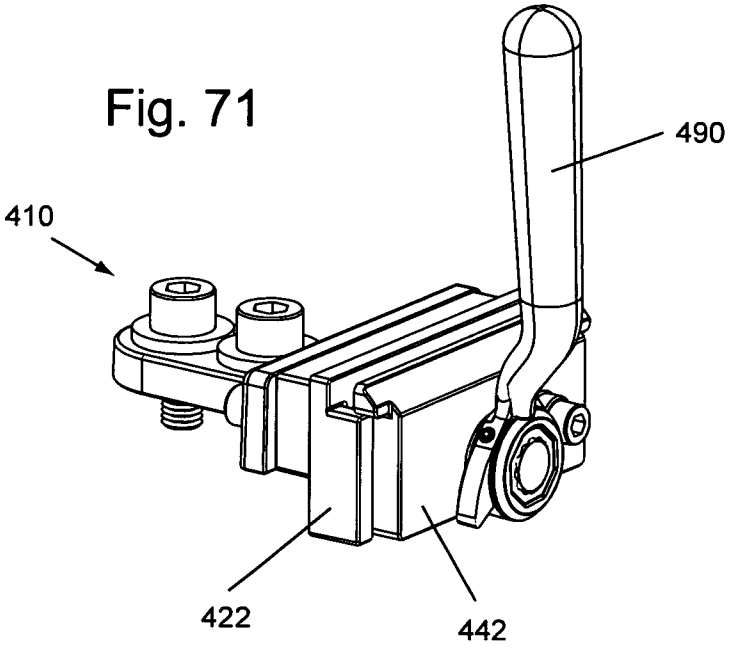


Fig. 70

Detail F

Fig. 71

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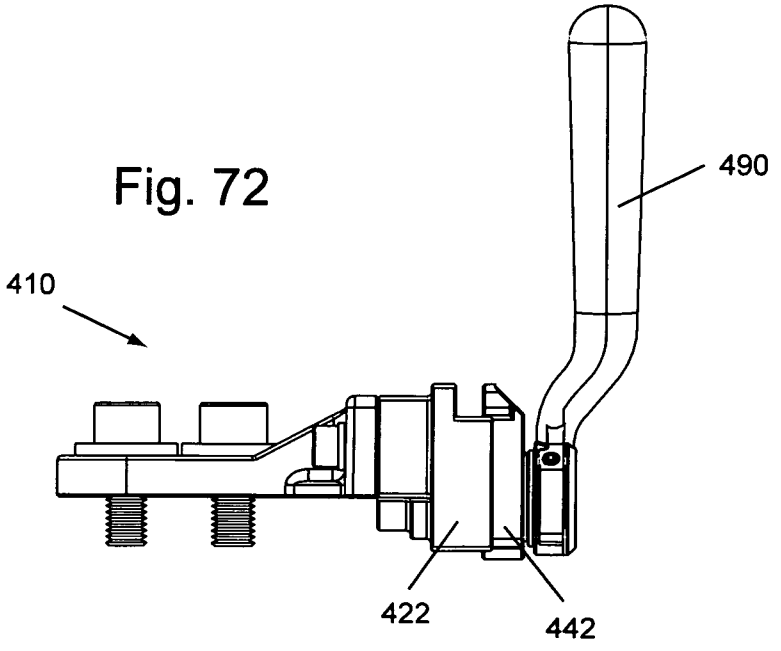

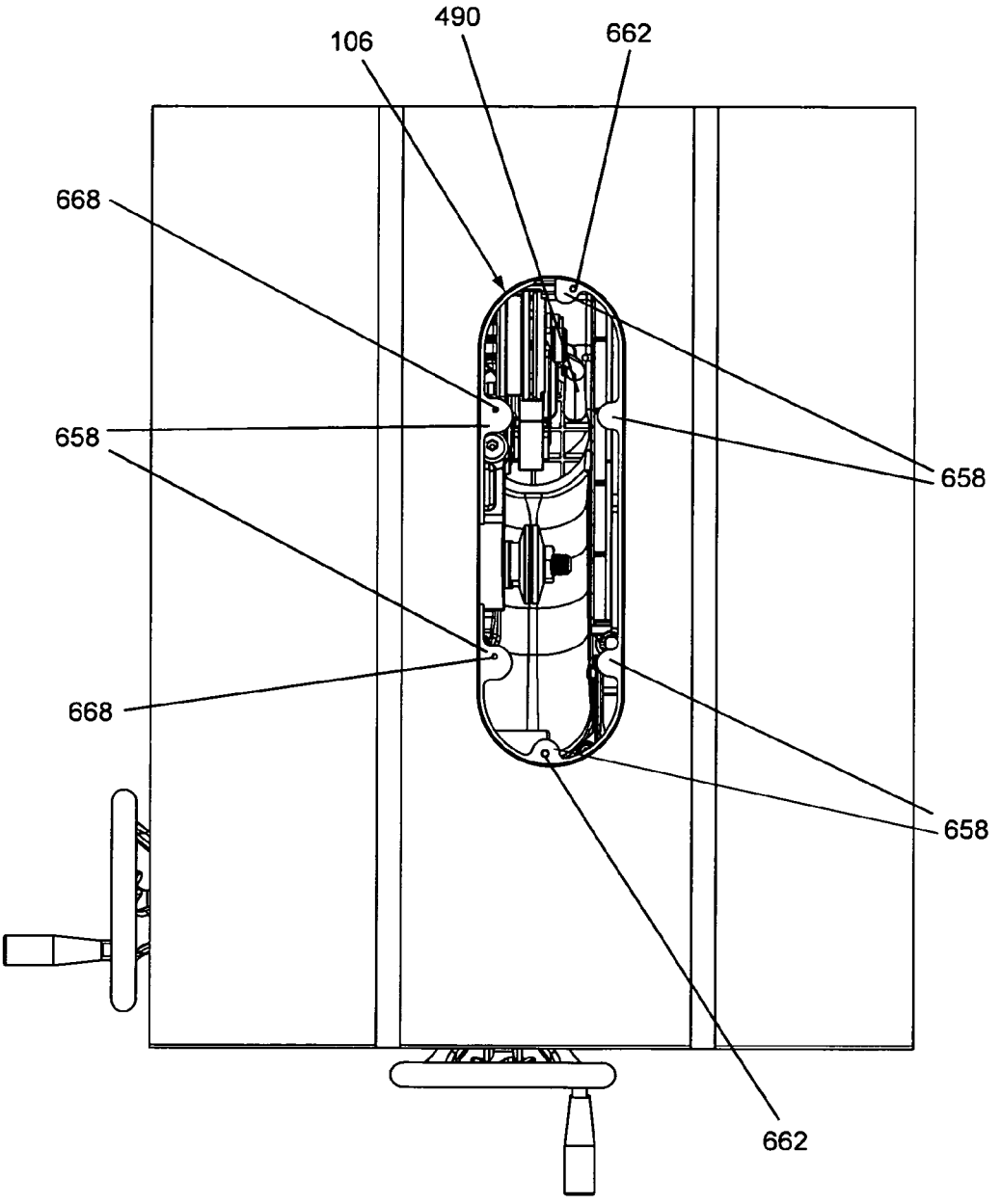


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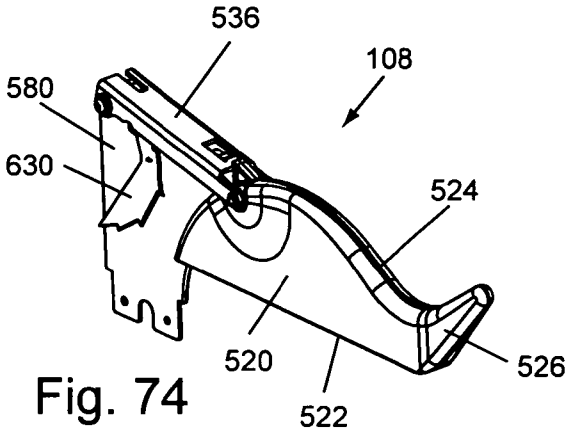


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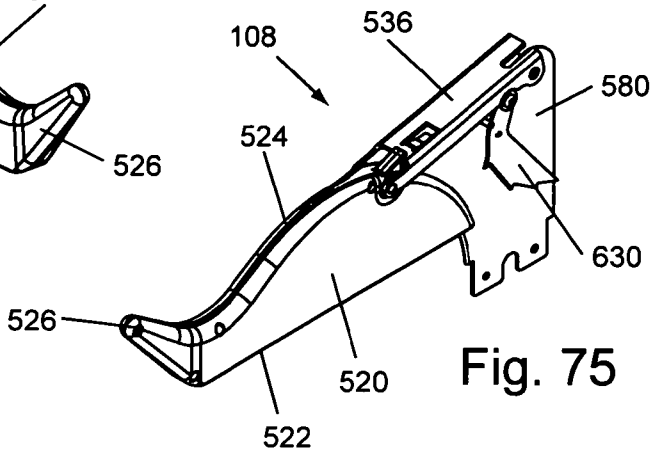
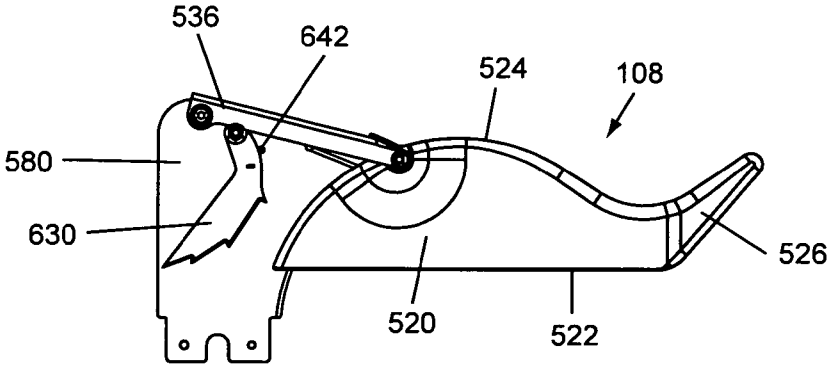



Fig. 75

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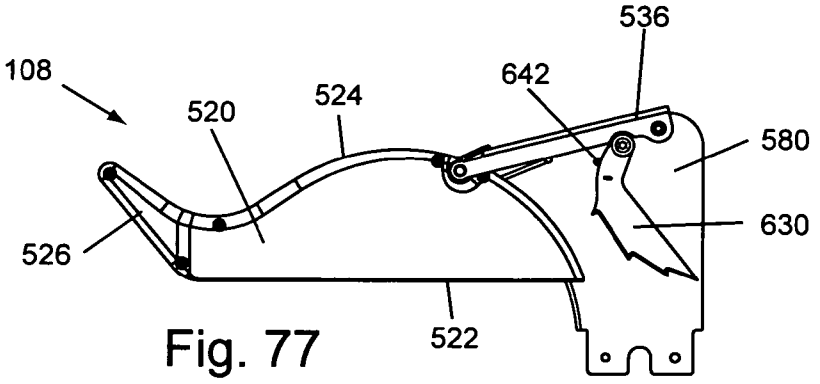


Fig. 77

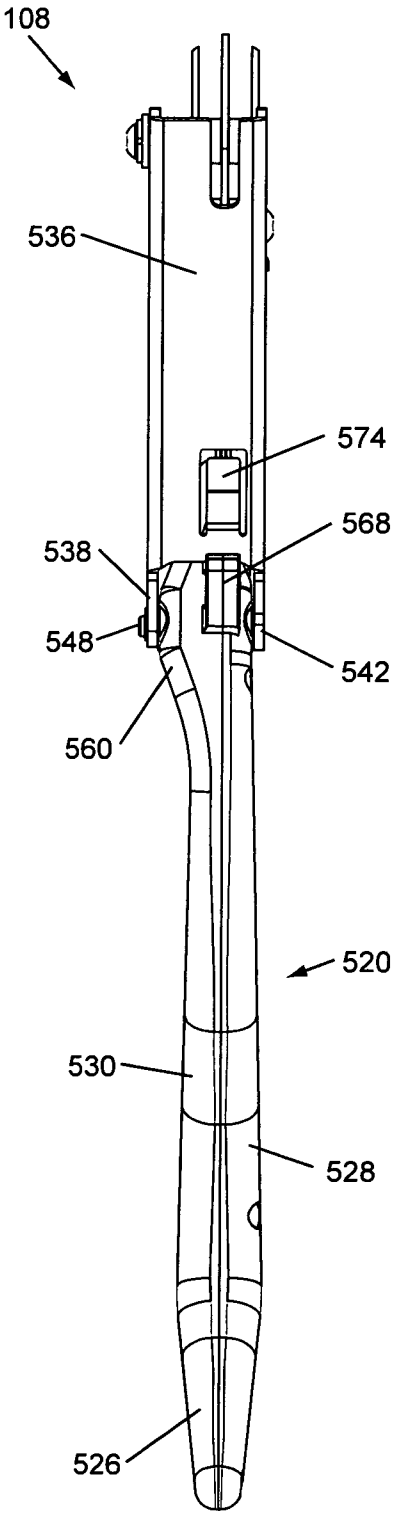
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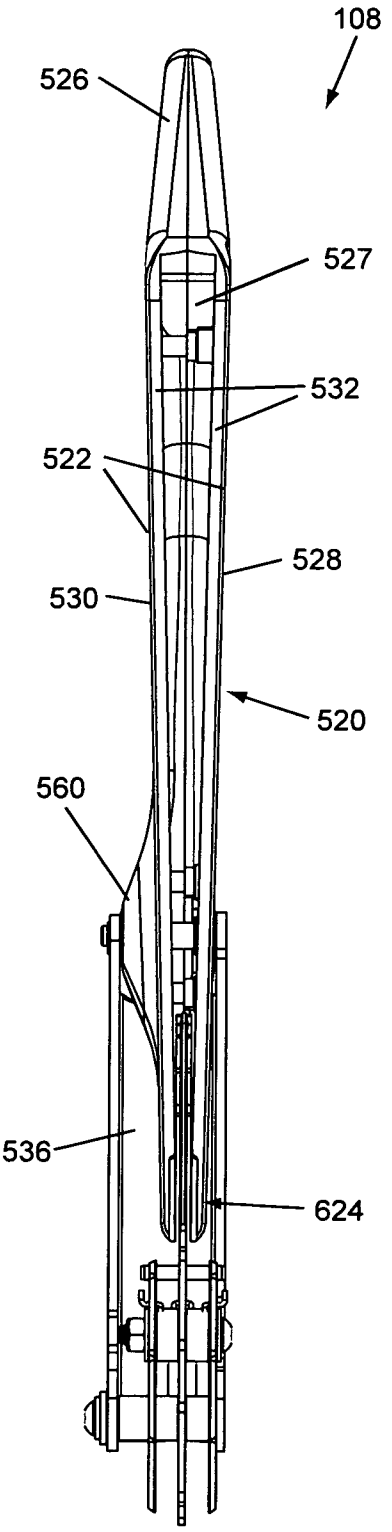
Fig. 78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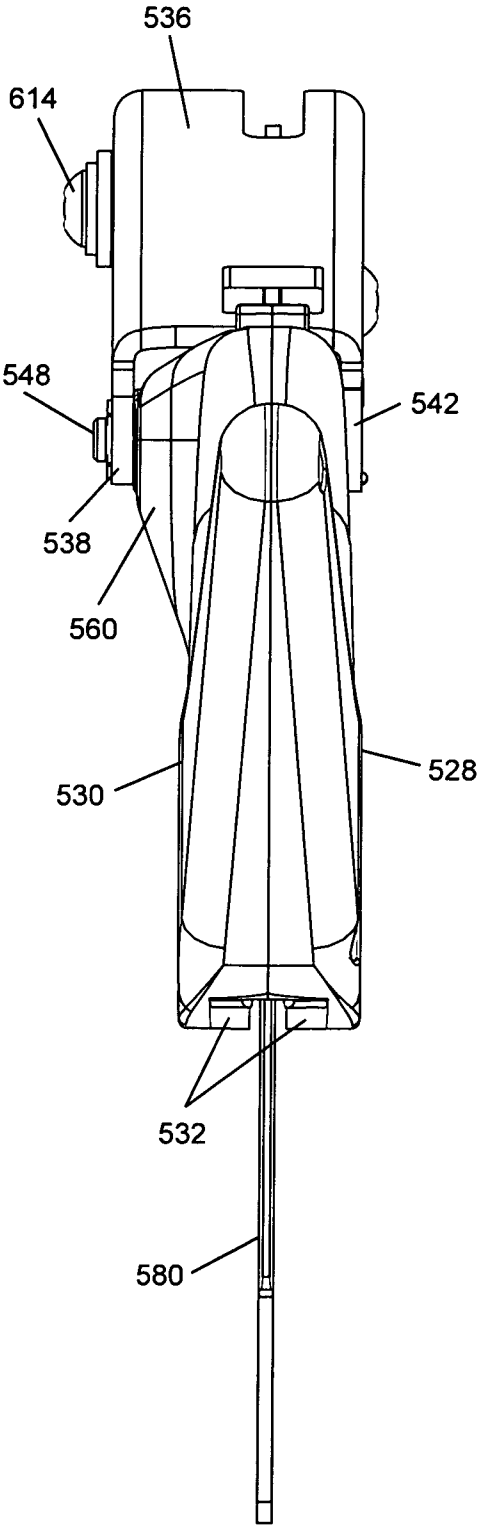
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Fig. 80

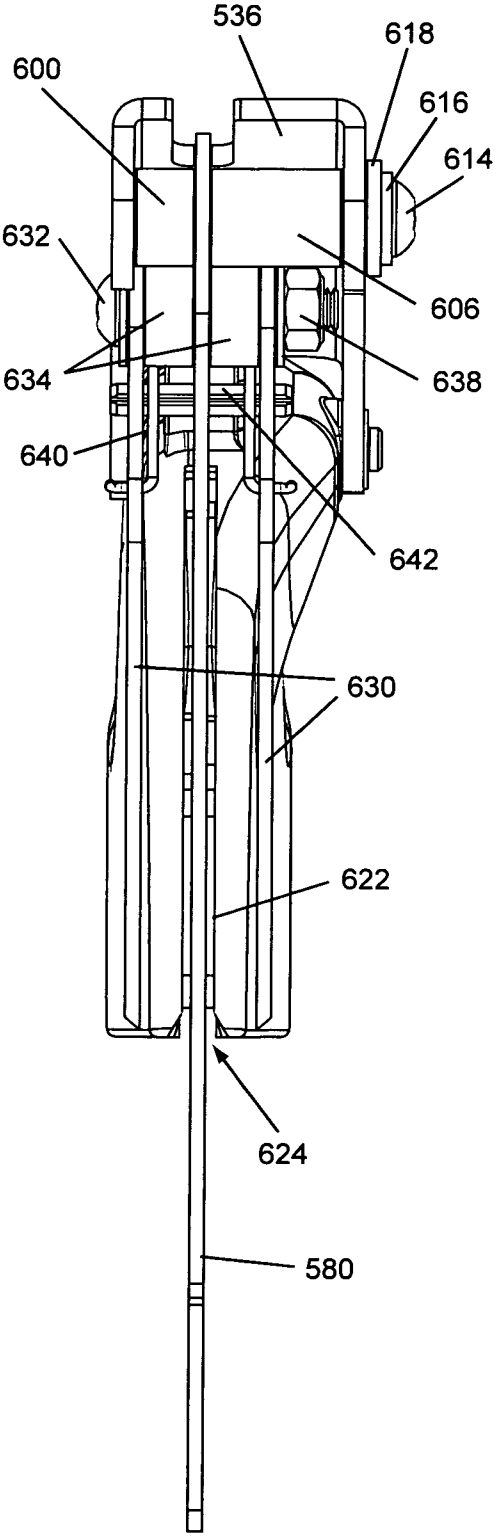
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Fig. 81

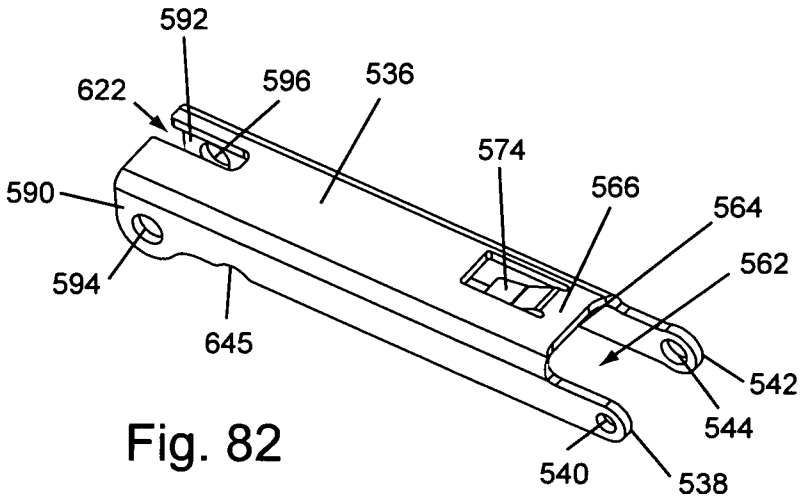
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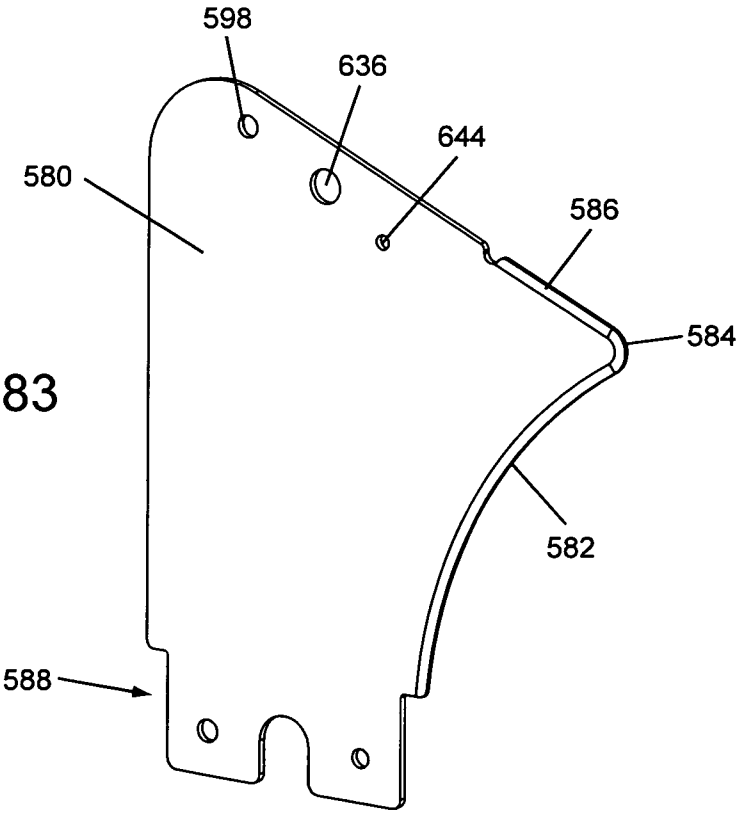
Fig. 82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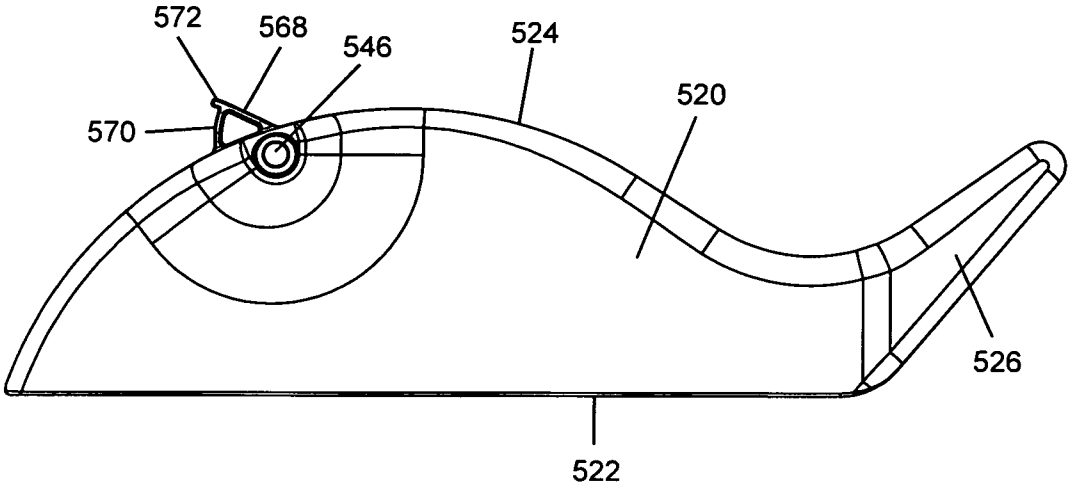
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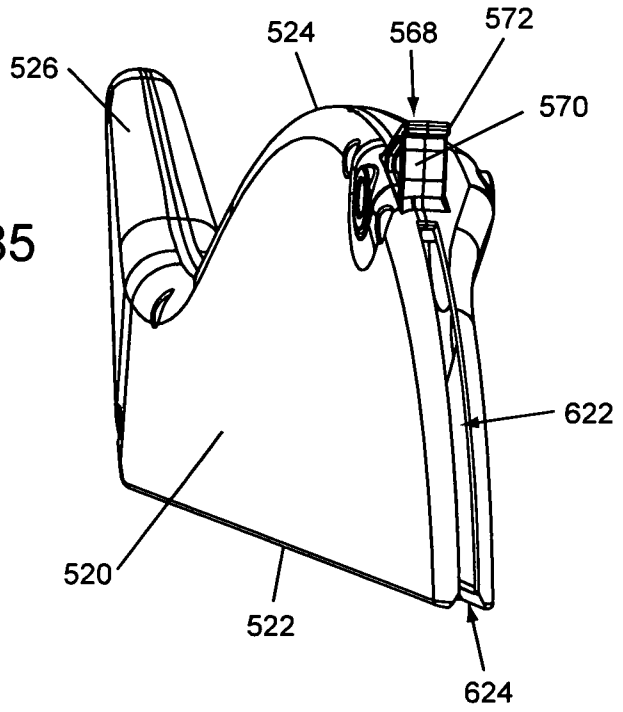
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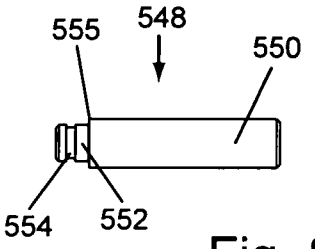
Fig. 85

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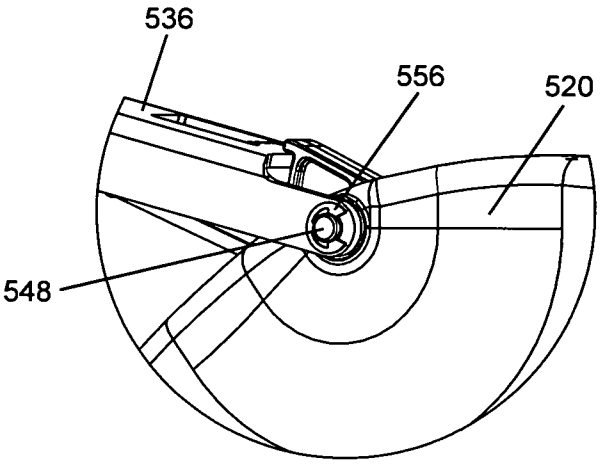


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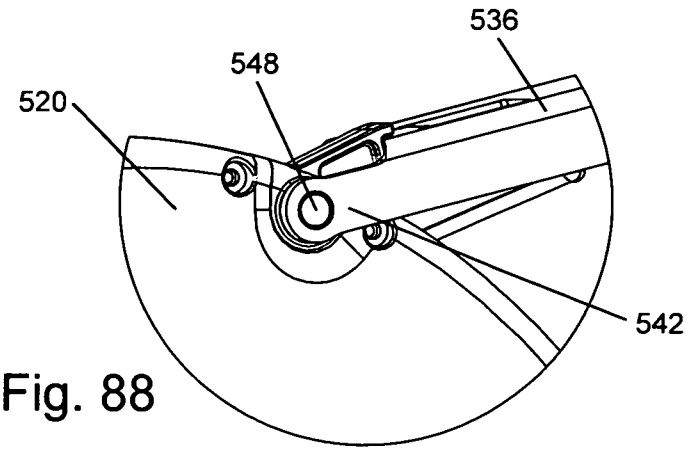


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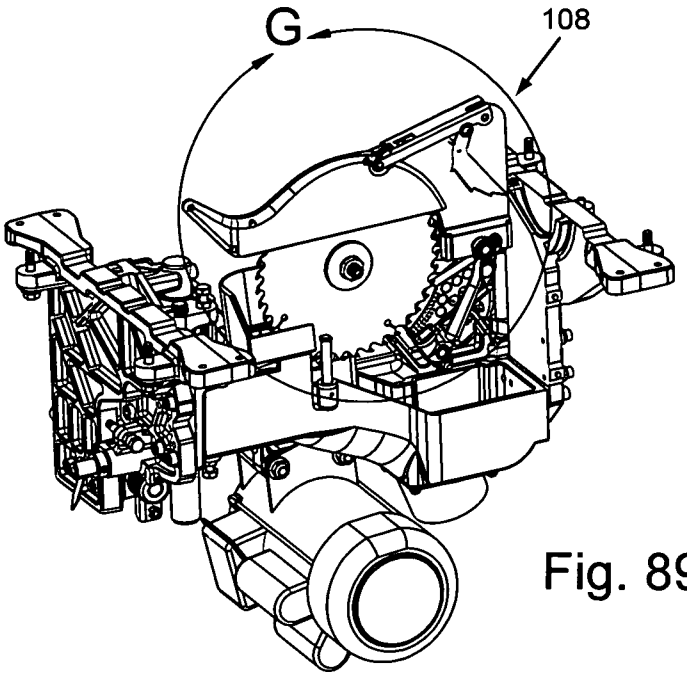


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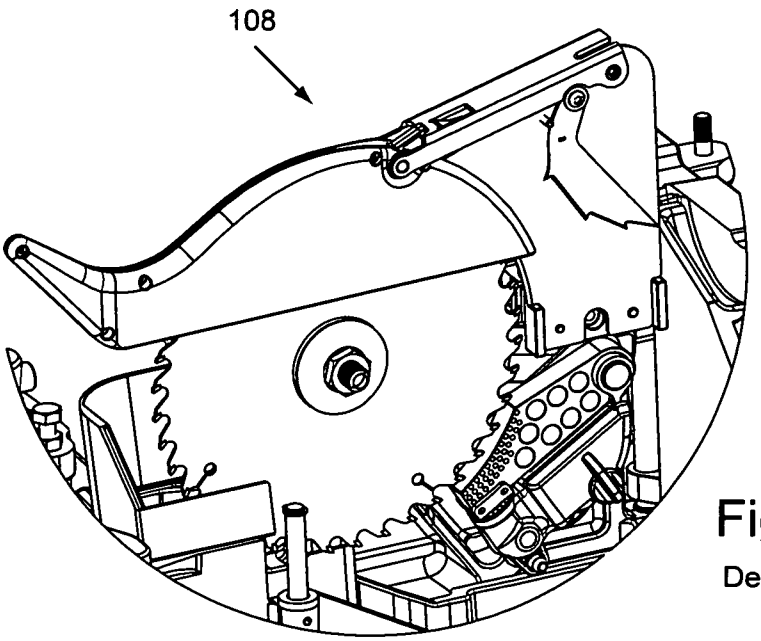



Fig. 90
Detail G

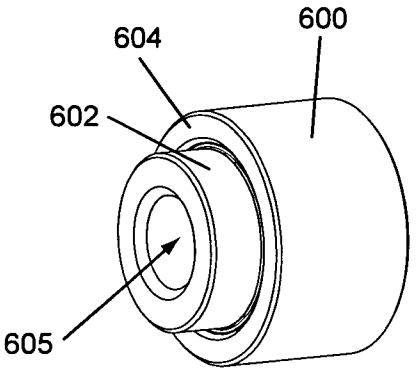
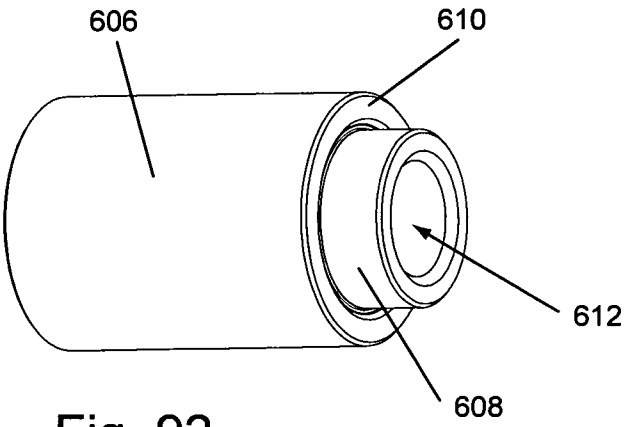



Fig. 91

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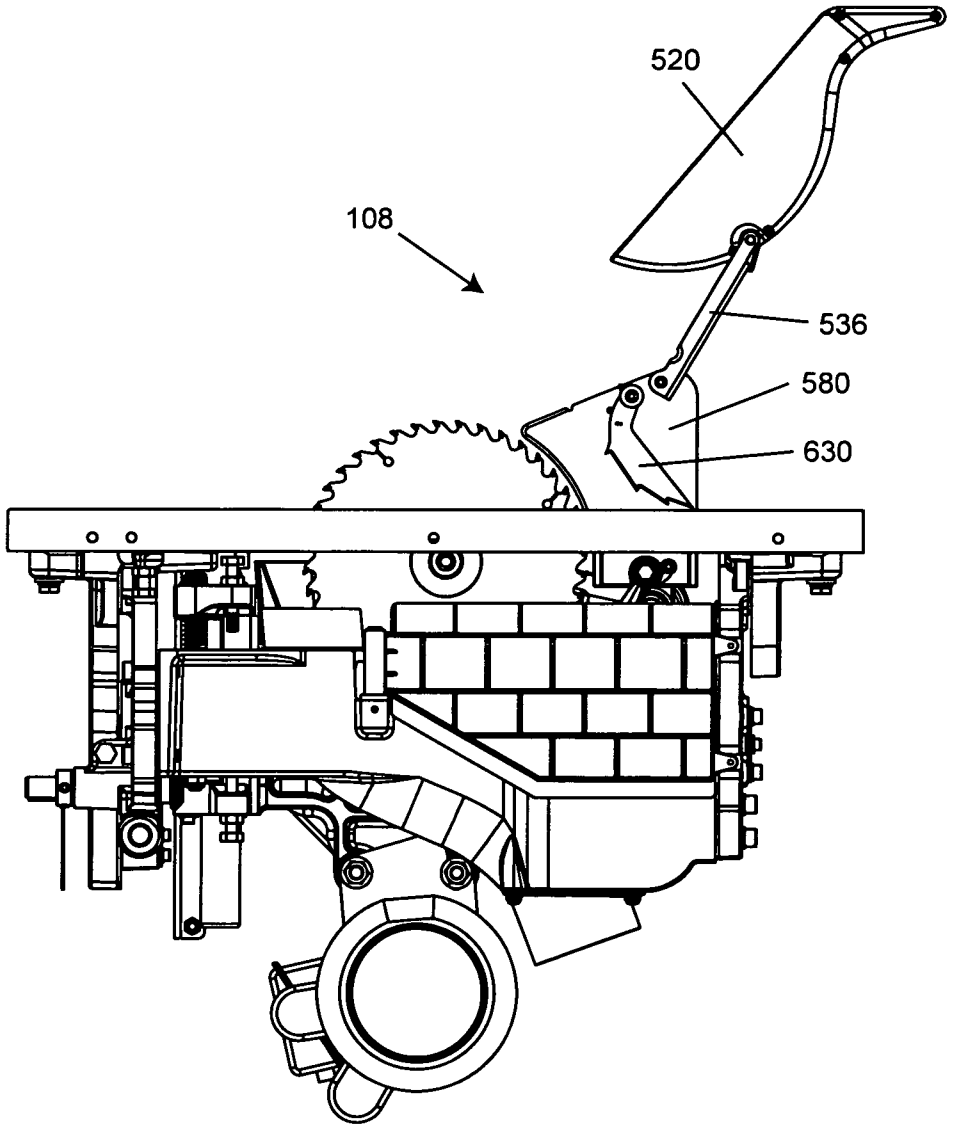


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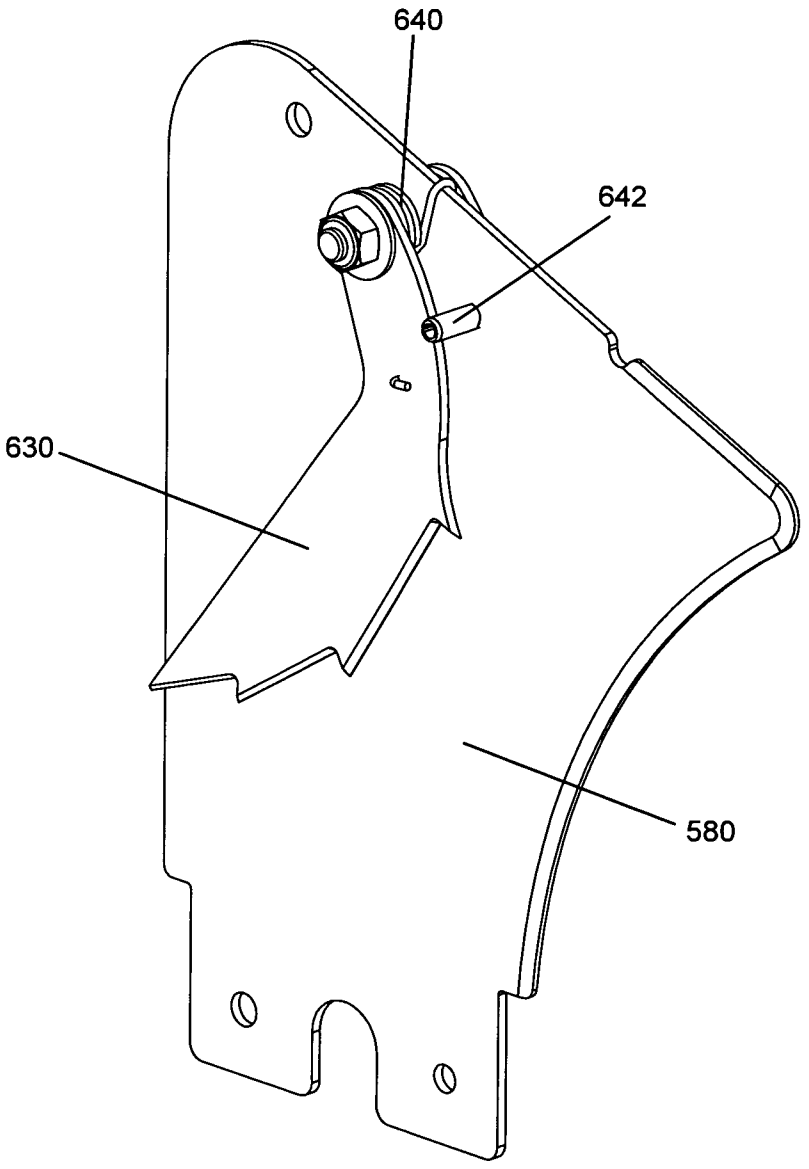


Fig. 94

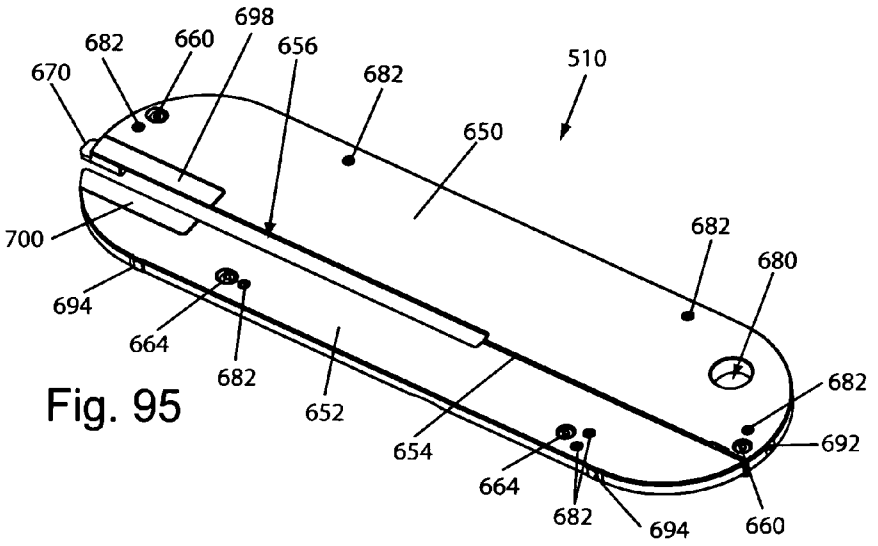


Fig. 95

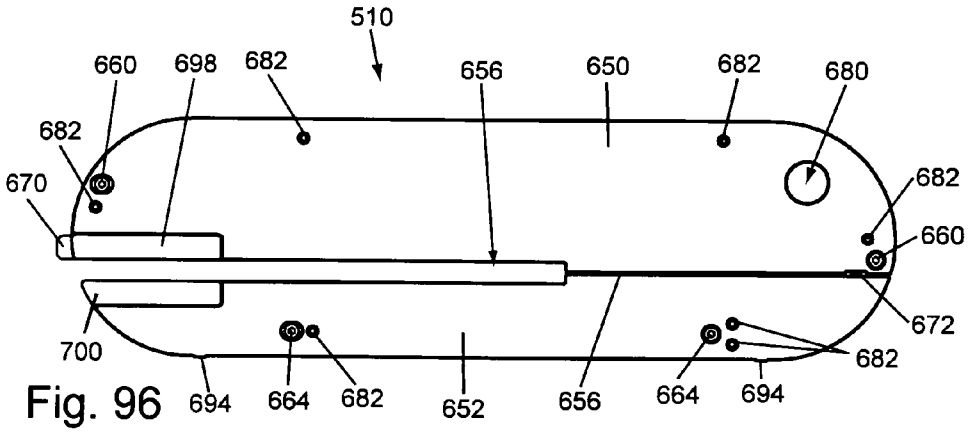


Fig. 96

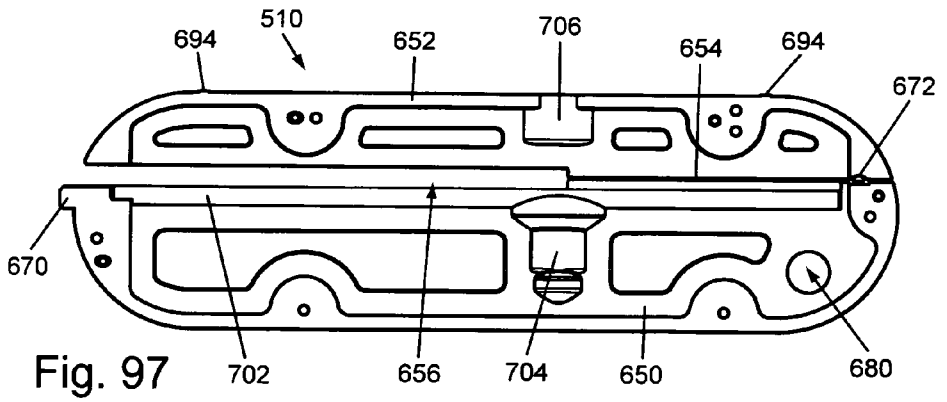


Fig. 97

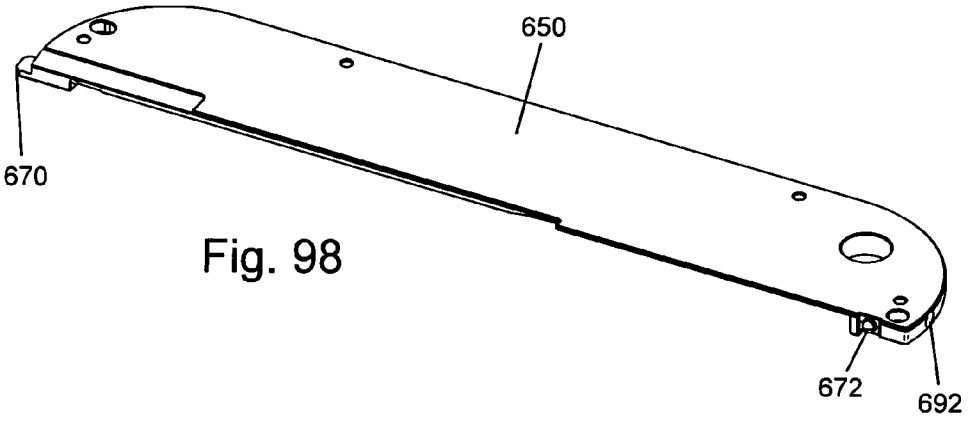


Fig. 98

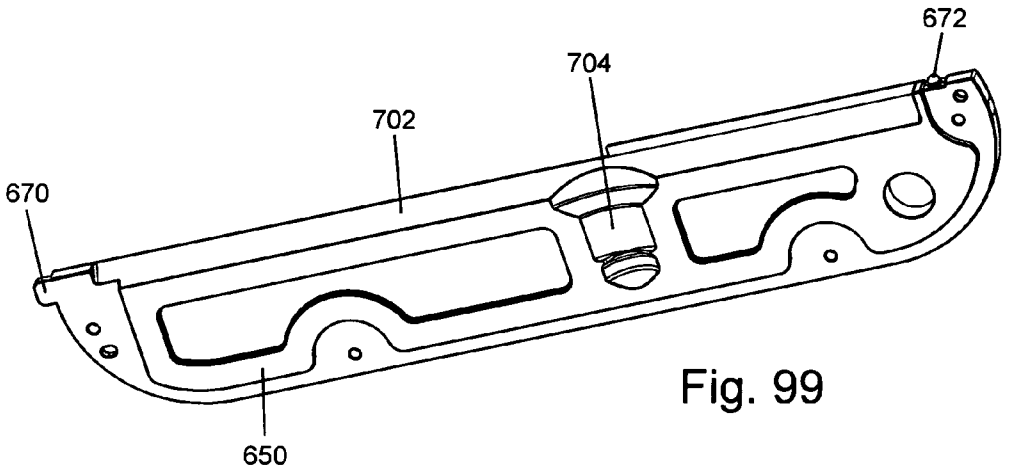


Fig. 99

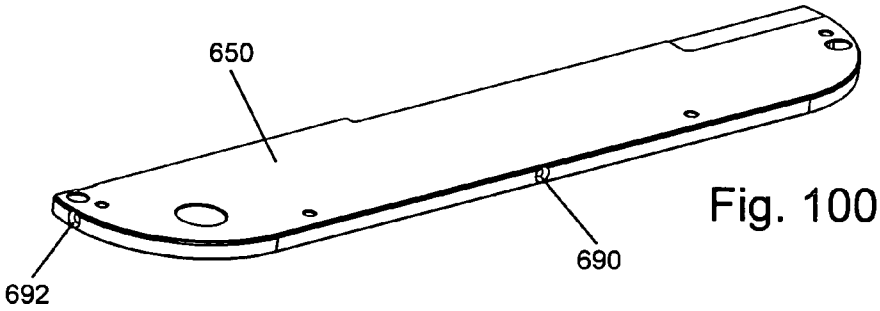


Fig. 100

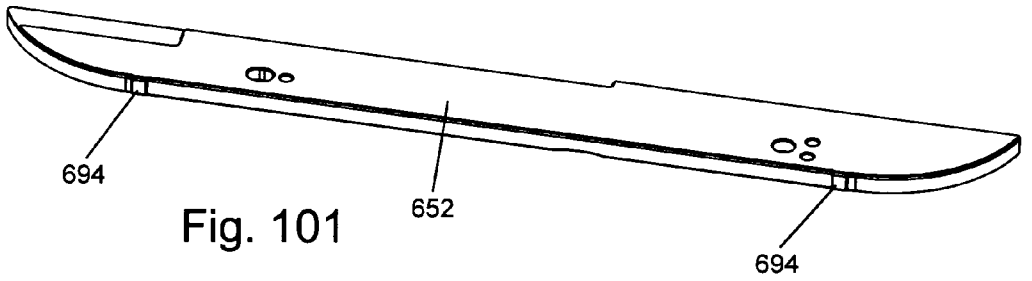


Fig. 101

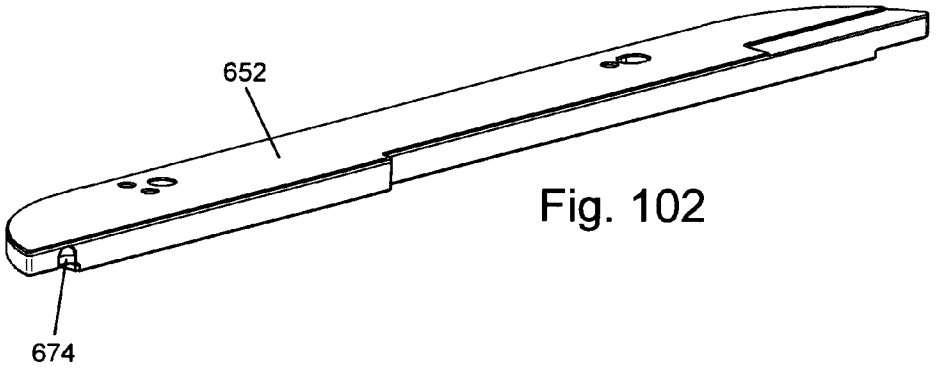


Fig. 102

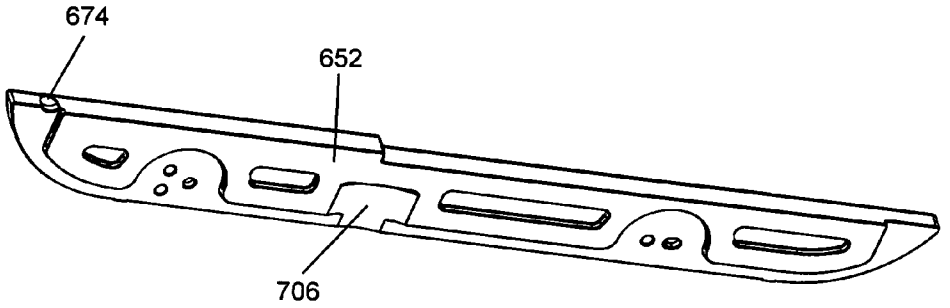


Fig. 103

# TABLE SAWS WITH SAFETY SYSTEMS AND SYSTEMS TO MOUNT AND INDEX ATTACHMENTS

## CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 11/045,972 filed Jan. 28, 2005, issuing as U.S. Pat. No. 7,827,890 B2 on Nov. 9, 2010, which in turn claimed the benefit of and priority from U.S. Provisional Patent Application Ser. No. 60/540,377 filed Jan. 29, 2004. The disclosures of these applications and patent are hereby incorporated by reference in their entireties.

## TECHNICAL FIELD

This specification relates to table saws. More particularly, this specification relates to safety systems for table saws, to mounting systems for table saw attachments, and to table saw attachments such as riving knives, blade guards, splitters and anti-kickback devices.

## BACKGROUND

A table saw is a power tool used to cut a work piece to a desired size or shape. A table saw includes a work surface or table and a circular blade extending up through the table. A person uses a table saw by holding a work piece on the table and feeding it past the spinning blade to make a cut. The table saw is one of the most basic machines used in woodworking.

The blade of a table saw, however, presents a risk of injury to a user of the saw. If the user accidentally places their hand in the path of the blade, or if their hand slips into the blade, then the user could receive a serious injury or amputation. Accidents also happen because of what is called kickback. Kickback may occur when a work piece contacts the downstream edge of the blade as it is being cut. The blade then propels the work piece back toward the user at a high velocity. When this happens, the user's hand may be carried into the blade because of the sudden and unexpected movement of the work piece

Safety systems or features are often incorporated into table saws to minimize the risk of injury. Probably the most common safety feature is a guard that physically blocks an operator from making contact with the blade. In many cases, guards effectively reduce the risk of injury, however, there are many instances where the nature of the operations to be performed precludes using a guard that completely blocks access to the blade.

Another safety device sometimes incorporated into table saws is a riving knife. A riving knife is a fin-like plate positioned adjacent the rear edge of the saw blade and within the projected kerf and top-to-bottom cutting capacity of the blade. A riving knife functions to keep a work piece from shifting sideways and catching on the rear edge of the blade and being kicked back at the user by the blade. The riving knife is mounted in a table saw so that it remains in a fixed position relative to the blade as the blade tilts and changes elevation.

Some table saws include a spreader or splitter instead of a riving knife. A splitter is a flat plate, similar to a riving knife, but typically extending above the top-to-bottom cutting capacity of the blade so that a blade guard can be mounted thereto. An anti-kickback device such as anti-kickback pawls, which are toothed pawls positioned to oppose a work piece being thrown back toward a user, are often mounted on the splitter. Splitters typically tilt with the blade, but do not move up and down with the blade.



Other safety systems have been developed to detect when a human body contacts a predetermined portion of a machine, such as detecting when a user's hand touches the moving blade on a saw. When that contact is detected, the safety systems react to minimize injury. These systems may be used in conjunction with table saw attachments such as blade guards, riving knives, splitters and anti-kickback pawls.

The present document discloses improved table saws, table saw components, systems to mount and index table saw attachments, and table saw attachments such as riving knives, blade guards, splitters and anti-kickback pawls.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic block diagram of a machine with a fast-acting safety system.

FIG. **2** is a schematic diagram of an exemplary safety system in the context of a machine having a circular blade.

FIG. **3** shows a table saw.

FIG. **4** shows a right-side view of the internal mechanism of the saw shown in FIG. **3**.

FIG. **5** shows a left-side view of the internal mechanism of the saw shown in FIG. **3**.

FIG. **6** shows a front view of the internal mechanism of the saw shown in FIG. **3**.

FIG. **7** shows a back view of the internal mechanism of the saw shown in FIG. **3**.

FIG. **8** shows a top view of the internal mechanism of the saw shown in FIG. **3** with the table removed.

FIG. **9** shows a bottom view of the internal mechanism of the saw shown in FIG. **3**.

FIG. **10** shows a front-right perspective view of the internal mechanism of the saw with the table removed.

FIG. **11** shows a front-left perspective view of the internal mechanism of the saw with the table removed.

FIG. **12** shows a back-right perspective view of the internal mechanism of the saw.

FIG. **13** shows a back-left perspective view of the internal mechanism of the saw.

FIG. **14** shows a right-side view of a trunnion brace used in the saw shown in FIG. **3**.

FIG. **15** shows a top view of a trunnion brace used in the saw shown in FIG. **3**.

FIG. **16** shows a left-side view of a trunnion brace used in the saw shown in FIG. **3**.

FIG. **17** shows part of the internal mechanism of the saw with a portion labeled "A" designated for a detailed view.

FIG. **18** is the detail view of the portion labeled "A" in FIG. **17**, showing part of a tilt control mechanism.

FIG. **19** shows part of the internal mechanism of the saw with a portion labeled "B" designated for a detailed view.

FIG. **20** is the detail view of the portion labeled "B" in FIG. **19**, showing part of a tilt control mechanism.

FIG. **21** shows a right-side view of an elevation plate and elevation system.

FIG. **22** shows a left-side view of an elevation plate and elevation system.

FIG. **23** shows a top view of an elevation plate and elevation system.

FIG. **24** shows a bottom view of an elevation plate and elevation system.

FIG. **25** shows a perspective view of an elevation plate and elevation system with portions labeled "C" and "D" designated for detail views.

FIG. **26** is the detail view of the portion labeled "C" in FIG. **25**, showing part of an elevation system.

FIG. **27** is the detail view of the portion labeled "D" in FIG. **25**, showing part of an elevation system.

FIG. **28** is a perspective top view of part of the internal mechanism of the saw shown in FIG. **3**, including an elevation plate and arbor assembly.

FIG. **29** is a bottom view of the components shown in FIG. **28**.

FIG. **30** is a right-side view of part of the internal mechanism of the saw shown in FIG. **3**, including an elevation plate, arbor assembly, brake cartridge and blade.

FIG. **31** is a left-side view of part of the internal mechanism of the saw shown in FIG. **3**, including an elevation plate, arbor assembly, brake cartridge, blade and arbor block support mechanism.

FIG. **32** shows an arbor block and arbor used in the saw shown in FIG. **3**.

FIG. **33** shows a portion of the internal mechanism of the saw shown in FIG. **3**, with a portion labeled "E" designated for a detail view.

FIG. **34** is the detail view of the portion labeled "E" in FIG. **33**, showing an arbor block support mechanism.

FIG. **35** shows an arbor block support mechanism.

FIG. **36** also shows an arbor block support mechanism.

FIG. **37** shows an eccentric bushing.

FIG. **38** shows two eccentric bushings end-to-end.

FIG. **39** shows shafts used in the elevation system of the saw shown in FIG. **3**.

FIG. **40** is a different view of the portion of the elevation system shown in FIG. **39**.

FIG. **41** is a top view of the portion of the elevation system shown in FIG. **39**.

FIG. **42** is a perspective, right-side view of an elevation plate.

FIG. **43** is a perspective, left-side view of the elevation plate shown in FIG. **42**.

FIG. **44** shows a table saw with a riving knife.

FIG. **45** shows a side view of the table saw shown in FIG. **44** with the cabinet and other parts removed for clarity.

FIG. **46** shows a top, perspective view of the saw shown in FIG. **45**.

FIG. **47** shows a top, perspective view of the saw shown in FIG. **45** with the table removed.

FIG. **48** shows a riving knife.

FIG. **49** shows another view of a riving knife.

FIG. **50** shows a mounting system or clamp for table saw attachments.

FIG. **51** shows another view of the mounting system shown in FIG. **50**.

FIG. **52** shows a top view of the mounting system shown in FIG. **50**.

FIG. **53** shows a cross-section view of the mounting system shown in FIG. **50** taken along the line **1-1** in FIG. **52**.

FIG. **54** shows a mounting plate used in the mounting system shown in FIG. **50**.

FIG. **55** shows another view of the mounting plate shown in FIG. **54**.

FIG. **56** shows a positioning plate used in the mounting system shown in FIG. **50**.

FIG. **57** shows another view of the positioning plate shown in FIG. **56**.

FIG. **58** shows still another view of the positioning plate shown in FIG. **56**.

FIG. **59** shows a clamping plate used in the mounting system shown in FIG. **50**.

FIG. **60** shows another view of the clamping plate shown in FIG. **59**.

FIG. **61** shows still another view of the clamping plate shown in FIG. **59**.

FIG. **62** shows a cam bushing used in the mounting system shown in FIG. **50**.

FIG. **63** shows another view of the cam bushing shown in FIG. **62**.

FIG. **64** shows still another view of the cam bushing shown in FIG. **62**.

FIG. **65** shows yet another view of the cam bushing shown in FIG. **62**.

FIG. **66** shows a handle used in the mounting system shown in FIG. **50**.

FIG. **67** shows still another view of the handle shown in FIG. **66**.

FIG. **68** shows yet another view of the handle shown in FIG. **66**.

FIG. **69** shows a saw assembly without a cabinet or table but with a riving knife installed in a mounting system.

FIG. **70** shows a detailed view of a section F from FIG. **69** with part of the mounting system removed.

FIG. **71** shows the mounting system of FIG. **50** in an open position.

FIG. **72** shows another view of the mounting system of FIG. **50** in an open position.

FIG. **73** shows a top view of a table saw with a table insert removed.

FIG. **74** shows a blade guard assembly.

FIG. **75** shows another view of the blade guard assembly shown in FIG. **74**.

FIG. **76** shows still another view of the blade guard assembly shown in FIG. **74**.

FIG. **77** shows yet another view of the blade guard assembly shown in FIG. **74**.

FIG. **78** shows a top view of the blade guard assembly shown in FIG. **74**.

FIG. **79** shows a bottom view of the blade guard assembly shown in FIG. **74**.

FIG. **80** shows a front view of the blade guard assembly shown in FIG. **74**.

FIG. **81** shows a back view of the blade guard assembly shown in FIG. **74**.

FIG. **82** shows a support arm used in the blade guard assembly shown in FIG. **74**.

FIG. **83** shows a spreader or splitter used in the blade guard assembly shown in FIG. **74**.

FIG. **84** shows a blade shroud used in the blade guard assembly shown in FIG. **74**.

FIG. **85** shows another view of the blade shroud used in the blade guard assembly of FIG. **74**.

FIG. **86** shows a pivot pin used in the blade guard assembly shown in FIG. **74**.

FIG. **87** shows a pivot connection used in the blade guard assembly shown in FIG. **74**.

FIG. **88** shows another view of the pivot connection shown in FIG. **87**.

FIG. **89** shows a blade guard assembly mounted in a saw assembly.

FIG. **90** shows a detailed view of a section G from FIG. **89** with part of a mounting system removed.

FIG. **91** shows a nut used in the blade guard assembly shown in FIG. **74**.

FIG. **92** shows a spacer used in the blade guard assembly shown in FIG. **74**.

FIG. **93** shows a blade guard assembly mounted in a saw assembly with the blade guard up.

FIG. **94** shows a splitter and anti-kickback device used in the blade guard assembly shown in FIG. **74**.

FIG. **95** shows a two-piece table insert.

FIG. **96** shows a top view of the table insert shown in FIG. **95**.

FIG. **97** shows a bottom view of the table insert shown in FIG. **95**.

FIG. **98** shows the right portion of the table insert shown in FIG. **95**.

FIG. **99** shows another view of the right portion of the table insert shown in FIG. **95**.

FIG. **100** shows still another view of the right portion of the table insert shown in FIG. **95**.

FIG. **101** shows the left portion of the table insert shown in FIG. **95**.

FIG. **102** shows another view of the left portion of the table insert shown in FIG. **95**.

FIG. **103** shows still another view of the left portion of the table insert shown in FIG. **95**.

## DETAILED DESCRIPTION

A machine that incorporates a safety system to detect and react to a dangerous condition, such as human contact with a designated portion of the machine, is shown schematically in FIG. **1** and indicated generally at **10**. Machine **10** may be any of a variety of different machines, such as table saws, miter saws, band saws, jointers, shapers, routers, hand-held circular saws, up-cut saws, sanders, etc. Machine **10** includes an operative structure **12** having a working or cutting tool **14** and a motor assembly **16** adapted to drive the cutting tool. Machine **10** also includes a safety system **18** configured to minimize the potential of a serious injury to a person using the machine. Safety system **18** is adapted to detect the occurrence of one or more dangerous conditions during use of the machine. If such a dangerous condition is detected, safety system **18** is adapted to engage operative structure **12** to limit any injury to the user caused by the dangerous condition.

Machine **10** also includes a suitable power source **20** to provide power to operative structure **12** and safety system **18**. Power source **20** may be an external power source such as line current, or an internal power source such as a battery. Alternatively, power source **20** may include a combination of both external and internal power sources. Furthermore, power source **20** may include two or more separate power sources, each adapted to power different portions of machine **10**.

It will be appreciated that operative structure **12** may take any one of many different forms. For example, operative structure **12** may include a stationary housing configured to support motor assembly **16** in driving engagement with cutting tool **14**. Alternatively, operative structure **12** may include one or more transport mechanisms adapted to convey a work piece toward and/or away from cutting tool **14**.

Motor assembly **16** includes at least one motor adapted to drive cutting tool **14**. The motor may be either directly or indirectly coupled to the cutting tool, and may also be adapted to drive work piece transport mechanisms. The particular form of cutting tool **14** will vary depending upon the various embodiments of machine **10**. For example, cutting tool **14** may be a single, circular rotating blade having a plurality of teeth disposed along the perimetrical edge of the blade. Alternatively, the cutting tool may be a plurality of circular blades, such as a dado blade or dado stack, or some other type of blade or working tool.

Safety system **18** includes a detection subsystem **22**, a reaction subsystem **24** and a control subsystem **26**. Control subsystem **26** may be adapted to receive inputs from a variety of sources including detection subsystem **22**, reaction subsystem **24**, operative structure **12** and motor assembly **16**. The control subsystem may also include one or more sensors adapted to monitor selected parameters of machine **10**. In addition, control subsystem **26** typically includes one or more instruments operable by a user to control the machine. The control subsystem is configured to control machine **10** in response to the inputs it receives.

Detection subsystem **22** is configured to detect one or more dangerous or triggering conditions during use of machine **10**. For example, the detection subsystem may be configured to detect that a portion of the user's body is dangerously close to or in contact with a portion of cutting tool **14**. As another example, the detection subsystem may be configured to detect the rapid movement of a workpiece due to kickback by the cutting tool, as is described in U.S. patent application Ser. No. 09/676,190, the disclosure of which is herein incorporated by reference. In some embodiments, detection subsystem **22** may inform control subsystem **26** of the dangerous condition, which then activates reaction subsystem **24**. In other embodiments, the detection subsystem may be adapted to activate the reaction subsystem directly.

Once activated in response to a dangerous condition, reaction subsystem **24** is configured to engage operative structure **12** quickly to prevent serious injury to the user. It will be appreciated that the particular action to be taken by reaction subsystem **24** will vary depending on the type of machine **10** and/or the dangerous condition that is detected. For example, reaction subsystem **24** may be configured to do one or more of the following: stop the movement of cutting tool **14**, disconnect motor assembly **16** from power source **20**, place a barrier between the cutting tool and the user, or retract the cutting tool from its operating position, etc. The reaction subsystem may be configured to take a combination of steps to protect the user from serious injury. Placement of a barrier between the cutting tool and teeth is described in more detail in U.S. Patent Application Publication No. 2002/0017183 A1, entitled "Cutting Tool Safety System," the disclosure of which is herein incorporated by reference. Retracting the cutting tool is described in more detail in U.S. Patent Application Publication No. 2002/0017181 A1, entitled "Retraction System for Use in Power Equipment," and U.S. patent application Ser. No. 60/452,159, filed Mar. 5, 2003, entitled "Retraction System and Motor Position for Use With Safety Systems for Power Equipment," the disclosures of which are herein incorporated by reference.

The configuration of reaction subsystem **24** typically will vary depending on which action or actions are taken. In the exemplary embodiment depicted in FIG. **1**, reaction subsystem **24** is configured to stop the movement of cutting tool **14** and includes a brake mechanism **28**, a biasing mechanism **30**, a restraining mechanism **32**, and a release mechanism **34**. Brake mechanism **28** is adapted to engage operative structure **12** under the urging of biasing mechanism **30**. During normal operation of machine **10**, restraining mechanism **32** holds the brake mechanism out of engagement with the operative structure. However, upon receipt of an activation signal by reaction subsystem **24**, the brake mechanism is released from the restraining mechanism by release mechanism **34**, whereupon, the brake mechanism quickly engages at least a portion of the operative structure to bring the cutting tool to a stop.

It will be appreciated by those of skill in the art that the exemplary embodiment depicted in FIG. **1** and described above may be implemented in a variety of ways depending on the type and configuration of operative structure **12**. Turning attention to FIG. **2**, one example of the many possible implementations of safety system **18** is shown. System **18** is con-

figured to engage an operative structure having a circular blade **40** mounted on a rotating shaft or arbor **42**. Blade **40** includes a plurality of cutting teeth (not shown) disposed around the outer edge of the blade. As described in more detail below, braking mechanism **28** is adapted to engage the teeth of blade **40** and stop the rotation of the blade. U.S. Patent Application Publication No. 2002/0017175 A1, entitled "Translation Stop For Use In Power Equipment," the disclosure of which is herein incorporated by reference, describes other systems for stopping the movement of the cutting tool. U.S. Patent Application Publication No. 2002/0017184 A1, entitled "Table Saw With Improved Safety System," U.S. Patent Application Publication No. 2002/0017179 A1, entitled "Miter Saw With Improved Safety System," U.S. Patent Application Publication No. 2002/0059855 A1, entitled "Miter Saw with Improved Safety System," U.S. Patent Application Publication No. 2002/0056350 A1, entitled "Table Saw With Improved Safety System," U.S. Patent Application Publication No. 2002/0059854 A1, entitled "Miter Saw With Improved Safety System," U.S. Patent Application Publication No. 2002/0056349 A1, entitled "Miter Saw With Improved Safety System," U.S. Patent Application Publication No. 2002/0056348 A1, entitled "Miter Saw With Improved Safety System," and U.S. Patent Application Publication No. 2002/0066346 A1, entitled "Miter Saw With Improved Safety System," U.S. Patent Application Publication No. 2003/0015253 A1, entitled "Router With Improved Safety System," U.S. Patent Application Publication No. 2002/0170400 A1, entitled "Band Saw With Improved Safety System," U.S. Patent Application Publication No. 2003/0019341 A1, entitled "Safety Systems for Band Saws," U.S. Patent Application Publication No. 2003/0056853 A1, entitled "Router With Improved Safety System," U.S. Provisional Patent Application Ser. No. 60/406,138, entitled "Miter Saw With Improved Safety System," and U.S. Provisional Patent Application Ser. No. 60/496,550, entitled "Table Saws With Safety Systems," the disclosures of which are herein incorporated by reference, describe safety system **18** in the context of particular types of machines.

In the exemplary implementation, detection subsystem **22** is adapted to detect the dangerous condition of the user coming into contact with blade **40**. The detection subsystem includes a sensor assembly, such as contact detection plates **44** and **46**, capacitively coupled to blade **40** to detect any contact between the user's body and the blade. Typically, the blade, or some larger portion of cutting tool **14** is electrically isolated from the remainder of machine **10**. Alternatively, detection subsystem **22** may include a different sensor assembly configured to detect contact in other ways, such as optically, resistively, etc. In any event, the detection subsystem is adapted to transmit a signal to control subsystem **26** when contact between the user and the blade is detected. Various exemplary embodiments and implementations of detection subsystem **22** are described in more detail in U.S. Patent Application Publication No. 2002/0017176 A1, entitled "Detection System For Power Equipment," U.S. Patent Application Publication No. 2002/0017336 A1, entitled "Apparatus And Method For Detecting Dangerous Conditions In Power Equipment," U.S. Patent Application Publication No. 2002/0069734 A1, entitled "Contact Detection System for Power Equipment," U.S. Patent Application Publication No. 2002/0190581 A1, entitled "Apparatus and Method for Detecting Dangerous Conditions in Power Equipment," U.S. Patent Application Publication No. 2003/0002942 A1, entitled "Discrete Proximity Detection System," U.S. Patent Application Publication No. 2003/0090224 A1, entitled "Detection System for Power Equipment," and U.S. Provisional Patent Application Ser. No. 60/533,791, entitled "Improved Detection Systems for Power Equipment," the disclosures of which are all herein incorporated by reference.

Control subsystem **26** includes one or more instruments **48** that are operable by a user to control the motion of blade **40**. Instruments **48** may include start/stop switches, speed controls, direction controls, light-emitting diodes, etc. Control subsystem **26** also includes a logic controller **50** connected to receive the user's inputs via instruments **48**. Logic controller **50** is also connected to receive a contact detection signal from detection subsystem **22**. Further, the logic controller may be configured to receive inputs from other sources (not shown) such as blade motion sensors, work piece sensors, etc. In any event, the logic controller is configured to control operative structure **12** in response to the user's inputs through instruments **48**. However, upon receipt of a contact detection signal from detection subsystem **22**, the logic controller overrides the control inputs from the user and activates reaction subsystem **24** to stop the motion of the blade. Various exemplary embodiments and implementations of control subsystem **26**, and components that may be used in control system **26**, are described in more detail in U.S. Patent Application Publication No. 2002/0020262 A1, entitled "Logic Control For Fast Acting Safety System," U.S. Patent Application Publication No. 2002/0017178 A1, entitled "Motion Detecting System For Use In Safety System For Power Equipment," U.S. Patent Application Publication No. 2003/0058121 A1, entitled "Logic Control With Test Mode for Fast-Acting Safety System," U.S. Provisional Patent Application Ser. No. 60/496,568, entitled "Motion Detecting System for use in a Safety System for Power Equipment," and U.S. Provisional Patent Application Ser. No. 60/533,598, titled "Switch Box for Power Tools with Safety Systems," the disclosures of which are all herein incorporated by reference.

In the exemplary implementation, brake mechanism **28** includes a pawl **60** mounted adjacent the edge of blade **40** and selectively moveable to engage and grip the teeth of the blade. Pawl **60** may be constructed of any suitable material adapted to engage and stop the blade. As one example, the pawl may be constructed of a relatively high strength thermoplastic material such as polycarbonate, ultrahigh molecular weight polyethylene (UHMW) or Acrylonitrile Butadiene Styrene (ABS), etc., or a metal such as fully annealed aluminum, etc. It will be appreciated that the construction of pawl **60** may vary depending on the configuration of blade **40**. In any event, the pawl is urged into the blade by a biasing mechanism in the form of a spring **66**. In the illustrative embodiment shown in FIG. **2**, pawl **60** is pivoted into the teeth of blade **40**. It should be understood that sliding or rotary movement of pawl **60** might also be used. The spring is adapted to urge pawl **60** into the teeth of the blade with sufficient force to grip the blade and quickly bring it to a stop.

The pawl is held away from the edge of the blade by a restraining mechanism in the form of a fusible member **70**. The fusible member is constructed of a suitable material adapted to restrain the pawl against the bias of spring **66**, and also adapted to melt under a determined electrical current density. Examples of suitable materials for fusible member **70** include NiChrome wire, stainless steel wire, etc. The fusible member is connected between the pawl and a contact mount **72**. Preferably, fusible member **70** holds the pawl relatively close to the edge of the blade to reduce the distance the pawl must travel to engage the blade. Positioning the pawl relatively close to the edge of the blade reduces the time required for the pawl to engage and stop the blade. Typically, the pawl

is held approximately 1/32-inch to 1/4-inch from the edge of the blade by fusible member **70**, however other pawl-to-blade spacings may also be used.

Pawl **60** is released from its unactuated, or cocked, position to engage blade **40** by a release mechanism in the form of a firing subsystem **76**. The firing subsystem is coupled to contact mount **72**, and is configured to melt fusible member **70** by passing a surge of electrical current through the fusible member. Firing subsystem **76** is coupled to logic controller **50** and activated by a signal from the logic controller. When the logic controller receives a contact detection signal from detection subsystem **22**, the logic controller sends an activation signal to firing subsystem **76**, which melts fusible member **70**, thereby releasing the pawl to stop the blade. Various exemplary embodiments and implementations of reaction subsystem **24** are described in more detail in U.S. Patent Application Publication No. 2002/0020263 A1, entitled "Firing Subsystem For Use In A Fast-Acting Safety System," U.S. Patent Application Publication No. 2002/0020271 A1, entitled "Spring-Biased Brake Mechanism for Power Equipment," U.S. Patent Application Publication No. 2002/0017180 A1, entitled "Brake Mechanism For Power Equipment," U.S. Patent Application Publication No. 2002/0059853 A1, entitled "Power Saw With Improved Safety System," U.S. Patent Application Publication No. 2002/0020265 A1, entitled "Translation Stop For Use In Power Equipment," U.S. Patent Application Publication No. 2003/0005588 A1, entitled "Actuators For Use in Fast-Acting Safety Systems," and U.S. Patent Application Publication No. 2003/0020336 A1, entitled "Actuators For Use In Fast-Acting Safety Systems," the disclosures of which are herein incorporated by reference.

It will be appreciated that activation of the brake mechanism will require the replacement of one or more portions of safety system **18**. For example, pawl **60** and fusible member **70** typically must be replaced before the safety system is ready to be used again. Thus, it may be desirable to construct one or more portions of safety system **18** in a cartridge that can be easily replaced. For example, in the exemplary implementation depicted in FIG. **2**, safety system **18** includes a replaceable cartridge **80** having a housing **82**. Pawl **60**, spring **66**, fusible member **70** and contact mount **72** are all mounted within housing **82**. Alternatively, other portions of safety system **18** may be mounted within the housing. In any event, after the reaction system has been activated, the safety system can be reset by replacing cartridge **80**. The portions of safety system **18** not mounted within the cartridge may be replaced separately or reused as appropriate. Various exemplary embodiments and implementations of a safety system using a replaceable cartridge, and various brake pawls, are described in more detail in U.S. Patent Application Publication No. 2002/0020261 A1, entitled "Replaceable Brake Mechanism For Power Equipment," U.S. Patent Application Publication No. 2002/0017182 A1, entitled "Brake Positioning System," U.S. Patent Application Publication No. 2003/0140749 A1, entitled "Brake Pawls for Power Equipment," and U.S. Provisional Patent Application Ser. No. 60/496,574, entitled "Brake Cartridges for Power Equipment," the disclosures of which are herein incorporated by reference.

While one particular implementation of safety system **18** has been described, it will be appreciated that many variations and modifications are possible. Many such variations and modifications are described in U.S. Patent Application Publication No. 2002/0170399 A1, entitled "Safety Systems for Power Equipment," U.S. Patent Application Publication No. 2003/0037651, entitled "Safety Systems for Power Equipment," and U.S. Patent Application Publication No. 2003/0131703 A1, entitled "Apparatus and Method for Detecting Dangerous Conditions in Power Equipment," the disclosures of which, are herein incorporated by reference.

A table saw adapted to implement features of the safety systems described above is shown at **100** in FIG. **3**. Saw **100** is often called a cabinet saw or a tilting-arbor saw. The saw includes a table **102** on which a work piece may be cut. The table is supported by a cabinet **104**. A blade **105** (labeled in FIGS. **4** through **7**) extends up through an opening **106** in the table and a blade guard **108** covers the blade. Hand wheels **110** and **112** may be turned to adjust the elevation of the blade (the height the blade extends above the table) and the tilt of the blade relative to the tabletop, respectively. In operation, a user turns the hand wheels to position the blade as desired and then makes a cut by pushing a work piece on the table past the spinning blade.

FIGS. **4** through **7** show various views of the internal mechanism of saw **100**. FIGS. **8** through **13** show additional views of the internal mechanism of the saw, but with the table removed. The remaining figures show various components and mechanisms that may be used in the saw.

Table **102** is bolted onto a front trunnion bracket **120** and a back trunnion bracket **122** by bolts **124** (the bolts are shown best in FIGS. **10** through **13**). The trunnion brackets, in turn, are bolted onto and supported by cabinet **104** through holes such as hole **107** shown in FIG. **8**. The cabinet is constructed to support the weight of the table and the internal mechanism of the saw. Alternatively, table **102** could be secured directly to the cabinet or some other support instead of to the trunnions.

It is important for the table to be positioned properly relative to the blade. Typically, the front edge of the table should be as perpendicular to the plane of the blade as possible in order to make straight, square cuts. There are many mechanisms by which the position of the table relative to the blade can be adjusted. FIGS. **4**, **5**, and **13** show one such mechanism. A pin **210** extends up from a flange in rear trunnion bracket **122**, as shown in FIG. **13**. That pin is positioned substantially in the side-to-side center of the rear trunnion bracket. Pin **210** extends up into a corresponding socket on the underside of the back edge of the table and the table is able to pivot around the pin. Table **102** includes two holes **212**, one in the right front side of the table and one in the left front side, as shown in FIGS. **4** and **5**. A bolt is threaded into each of those holes and extends through the side of the table. Holes **212** are positioned so that when the bolts are threaded through the holes, the ends of the bolts abut the right and left sides of the front trunnion bracket, respectively. Those sides are labeled **213** in FIG. **8**. Threading a bolt farther into its hole will cause the bolt to push against the front trunnion bracket and the table will then pivot around pin **210**. Thus, the position or squareness of the table relative to the blade can be adjusted by threading the bolts into holes **212** a desired amount.

Saw **100** also includes front and rear trunnions **126** and **128**. These trunnions are supported in the saw by the front and rear trunnion brackets, respectively. Each trunnion bracket includes an arcuate tongue or flange **130** (best seen in FIGS. **10** through **13**), and the front and rear trunnions each include a corresponding arcuate groove **132** (grooves **132** are labeled in FIGS. **10** and **12**). Trunnion brackets **120** and **122** support trunnions **126** and **128** by flanges **130** extending into corresponding grooves **132**. In this manner, the flanges provide a shoulder or surface on which the trunnions may rest. The arcuate tongue and groove connections also allow the trunnions to slide relative to the trunnion brackets. When the trunnions slide on the trunnion brackets, the blade of the saw

tilts relative to the tabletop because the blade is supported by the trunnions, as will be explained below.

A trunnion brace **134** extends between and interconnects the front and rear trunnions so that the trunnions move together. The trunnion brace also holds the front and rear trunnions square and prevents the trunnions from moving off flanges **132** when the mechanism is assembled. The trunnion brackets, trunnions and trunnion brace are shown isolated from other structure in FIGS. **14** through **16**.

The trunnions and trunnion brace are tilted relative to the trunnion brackets by gears. A rack gear **136** is cut into an edge of front trunnion **126**, and a worm gear **138** is mounted on front trunnion bracket **120** to mesh with the rack gear. This arrangement is shown in detail in FIGS. **17** through **20**. Worm gear **138** is mounted on a shaft **140** and the shaft is supported in a bracket **142**. A collar **143** holds the shaft in place in the bracket. Bracket **142** is bolted onto front trunnion bracket **120** by bolts **144**. The bolts pass through oversized holes in the front trunnion bracket and thread into holes in bracket **142**. The oversized holes in the front trunnion bracket allow for adjustment of the position of bracket **142** up or down relative to the rack gear. Being able to adjust the position of the bracket up or down is important in order to make sure the rack and worm gears mesh properly. Of course, the oversized holes may be in bracket **142** and the threaded holes may be in the front trunnion bracket.

Other mechanisms also may be used to align worm gear **138** with rack gear **136**. One such mechanism is one or more eccentric bushings that hold shaft **140** in bracket **142**. The bushings may be turned to move shaft **140** and worm gear **138** toward or away from rack gear **136** to make sure the gears mesh properly. A possible eccentric bushing is shown in FIG. **37** at **146**. The bushing includes a hole **148** positioned off-center from the longitudinal axis of the bushing, a hex head **150** to allow a person to turn the bushing, and shoulders **152**. The bushing is configured so that two such bushings may be positioned end to end, as shown in FIG. **38**, and shaft **140** may be supported in the resulting hole **148**. When the bushings are positioned in bracket **142**, turning either of the two hex heads **150** with a wrench will cause both bushings to turn because shoulders **152** abut, and turning the bushings will cause shaft **140** and worm gear **138** to move toward or away from rack gear **136** because hole **148** is off center.

Shaft **140** extends out through a hole in cabinet **104** and hand wheel **112** is mounted on the shaft. When a user turns hand wheel **112** and shaft **140**, worm gear **138** meshes with rack gear **136** causing the trunnions to move and the blade to tilt relative to the tabletop. A plate **154** is bolted to bracket **142** and extends up past rack gear **136**, as shown in FIG. **18**, to help prevent the bottom of front trunnion **126** from moving away from the front trunnion bracket and to help maintain the rack gear and worm gear in position.

Stops **155** and **156**, shown best in FIG. **6**, limit the distance that the trunnions and trunnion brace may move. Stop **155** comprises a bolt threaded through a shoulder in the front trunnion bracket and a lock nut to hold the bolt in place. The bolt is positioned so that it will abut a side edge of the front trunnion bracket when the front trunnion is at one limit of its movement, as shown in FIG. **6**. Stop **156** comprises a bolt threaded into a hole in the front trunnion bracket (also shown in FIG. **25**). A lock nut or some other means may be used to hold the bolt in place. The bolt is positioned so that the front trunnion will abut the head of the bolt when the front trunnion is at the opposite limit of its movement. The distance the trunnions may move can be adjusted by threading the bolts in stops **155** and **156** in or out, as desired.

Saw **100** typically includes a label **157** mounted on the front of the cabinet. Label **157** includes angle demarcations to indicate the degree the blade tilts relative to the tabletop. A pointer **158** is mounted on or adjacent shaft **140** to point to the angle demarcations on label **157**. For instance, when the blade is tilted 45 degrees relative to the tabletop, pointer **158** would point to the 45 degree mark on label **157**. In the depicted embodiment, pointer **158** is mounted to the front trunnion, adjacent shaft **140**.

Saw **100** also includes an elevation carriage shown as elevation plate **170**. The elevation plate is supported by the front and rear trunnions and tilts with the trunnions. The blade is supported on the elevation plate, as will be described, so tilting the elevation plate causes the blade to tilt. The elevation plate is also configured to move up and down relative to the trunnions. Moving the elevation plate up and down is what causes the blade to move up and down relative to the tabletop.

Elevation plate **170** includes two bores **180** and **182**, labeled in FIG. **42**. A bushing **184**, which may be made from oil impregnated bronze, fits into each bore and is held in place by screws and washers **185**. The washers overlap the edge of the bushing to prevent the bushing from moving out of the bore. A support shaft **172** fits into bores **180** and **182**, as shown in FIGS. **21** through **26**, and elevation plate **170** is free to slide up and down on the shaft. Shaft **172** is bolted onto front trunnion **126** to connect the elevation plate to the front trunnion. In the depicted embodiment, shaft **172** fits into two notches **174** in front trunnion **126**. Bolts **176** and **178** then secure the shaft to the front trunnion, as shown in FIGS. **39** through **41**. Bolt **176** extends through shaft **172** and threads into a hole in the front trunnion. Bolt **178** extends through the front trunnion and threads into shaft **172**. In this manner the shaft is securely anchored to the front trunnion. Shaft **172** may be mounted to the front trunnion in other ways as well.

The distance elevation plate **170** may slide up and down on shaft **172** is ultimately defined by the spacing between notches **174** on front trunnion **126** and the spacing between bores **180** and **182** on the elevation plate. That distance, however, may be further defined by adjustable stops **186** shown in FIG. **42**. These stops are made of bolts threaded through holes in the elevation plate and lock nuts to hold the bolts in place, as shown. The bolts are positioned so they abut a shoulder **188** extending out from the front trunnion bracket, as shown in FIG. **21**. (Shoulder **188** is also shown in FIGS. **39** and **41**.) The distance the elevation plate may slide up or down on shaft **172** is thus defined by how far the stops or bolts extend.

Elevation plate **170** also includes a threaded bore **190** configured to accept a threaded shaft **192**, shown best in FIGS. **21**, **28** and **39**. Shaft **192** also extends through a bore **193** in shoulder **188** on the front trunnion bracket to further support the shaft (bore **193** is labeled in FIGS. **15** and **41**). The threaded shaft may be held in bore **193** in any manner, such as by clips or collars. A bevel gear **194** is mounted on the end of shaft **192** below shoulder **188**. A second bevel gear **196** is mounted on a shaft **198** that extends perpendicularly relative to shaft **192**. Shaft **198** extends through and is supported for rotation by the front trunnion. A collar **200** holds shaft **198** in place. Shafts **192** and **198** are positioned so that the two bevel gears mesh. Shaft **198** also extends through a hole in cabinet **104** and hand wheel **110** is mounted on the shaft. When a person turns hand wheel **110**, bevel gear **196** causes threaded shaft **192** to turn. When threaded shaft **192** turns, elevation plate **170** moves up or down on the shaft because hole **190** is threaded. Moving the elevation plate up and down causes the blade to move up and down relative to the tabletop. In this manner, a user may adjust the elevation of the blade.

The construction of elevation plate **170** and shafts **172** and **192** may be referred to as a vertical slide because the elevation plate slides vertically on shaft **172**. Other constructions of vertical slides are also possible, such as using one or move dovetail slides instead of a shaft. Multiple vertical shafts may also be used instead of one shaft and multiple vertical shafts may be spaced apart to support the elevation plate. Shafts or dovetail slides may also be positioned at each end of the elevation plate instead of at one end only.

Additionally, a motor may be used instead of hand wheel **110** to turn the bevel gears to raise or lower the elevation plate, or a motorized lift may be used instead of the bevel gears. The motor or lift may be actuated by a typical switch or by a switch configured to be similar to a hand wheel.

Elevation plate **170**, and any components attached to the elevation plate (such as a motor, as will be discussed below), may have significant weight and therefore it may be difficult to turn hand wheel **110** to raise the blade. Accordingly, the depicted embodiment includes a gas spring **202** mounted at one end to the elevation plate and at the other end to a bracket **204** mounted to the front trunnion, as shown best in FIGS. **25** and **26**. The gas spring is biased to push the elevation plate up with a predetermined amount of force to make it easy for a user to turn hand wheel **110** to raise the blade. The force of the gas spring may be selected so that the elevation plate is biased up or down to take out any play or slack between threaded shaft **192** and threaded bore **190**. Forces in the range of 50 to 250 pounds may be used, depending on how much weight must be lifted.

It is important that elevation plate **170** be restricted from any side-to-side motion or rotation around the longitudinal axis of support shaft **172** in order to hold the saw blade straight, and support shaft **172** and threaded shaft **192** limit how the elevation plate may move. However, in the depicted embodiment, because the elevation plate is relatively long and supported principally at one end, and also because of manufacturing tolerances in shafts **172** and **192** and their corresponding bores in the elevation plate, there is a risk that the elevation plate may move slightly in an undesired manner, especially if the elevation plate is tilted. Accordingly, elevation plate **170** includes bores **220** and **222** in two projections at the distal end of the elevation plate, opposite bores **180** and **182**, and a guide shaft **224** is mounted in the bores. The guide shaft may be held in the bores by clips, bolts, or any other method.

A guide block **226** is placed on the guide shaft between bores **220** and **222** so the shaft can move up and down in the guide block. The guide block, in turn, is mounted to the apex of a V-bracket **228**, and the opposite two ends of the V-bracket are bolted to the rear trunnion **128**, as shown in FIGS. **25** and **27**. This arrangement allows the elevation plate to move up and down to change the elevation of the blade, but prevents the distal end of the elevation plate from moving to the side or rotating around shaft **172** because the V-bracket is bolted to the rear trunnion and the guide block is mounted to the V-bracket.

This arrangement also accommodates variances or tolerances in manufacturing. Guide shaft **224** should be substantially parallel with support shaft **172** so that the elevation plate can move up and down on shaft **172** without binding on shaft **224**. However, it may be difficult to make shaft **224** substantially parallel with shaft **172**, especially given that the shafts are spaced a significant distance apart.

In the depicted embodiment, guide shaft **224** may be mounted in an eccentric bushing **230**. Bushing **230** is similar to bushing **146** shown in FIG. **37**, except it does not need shoulders **152**. Bushing **230** has an off-center hole through which guide shaft **224** passes. The bushing is placed over the shaft and in bore **222** and held on the shaft by a clip. The bushing may then be turned to move the guide shaft and align the shaft as necessary. When the bushing is turned to its desired location, it is held in place by a set screw **232** shown in FIG. **27**.

Guide block **226** is bolted onto the apex of V-bracket **228**, as explained. A single bolt mounts the guide block to the V-bracket so the bracket can be adjusted or rotated around the bolt to align with the guide shaft so the guide shaft can slide up and down in the guide block.

The two ends of V-bracket **228** opposite the guide block are bolted to the rear trunnion by bolts **234**, as stated. The V-bracket itself is made of a material which has some flex, such as metal, and there is a distance between bolts **234** and guide block **226**. That distance and the flex of the material allow the V-bracket to flex out toward the rear of the saw if necessary to accommodate the guide shaft. That flex may be necessary if the distance of shaft **224** from shaft **172**, the position of shaft **172** or shaft **224** in the saw, or the dimension of other components in the saw varies due to manufacturing tolerances or other reasons. That flex also may be necessary to accommodate the expanding or contracting of the elevation plate due to temperature changes. Thus, the ability of the V-bracket to flex out helps prevent the guide shaft from binding in guide block **226**.

This mounting configuration may be thought of as constraining only one degree of freedom of the guide shaft; specifically, it constrains any side-to-side movement of the guide shaft. The mounting configuration allows the guide shaft and elevation plate to move up and down and front-to-back. This mounting configuration accommodates some misalignment of the guide shaft.

An arbor block **240** is pivotally mounted to the elevation plate as shown in FIGS. **28** and **29**. The arbor block includes two projections **244** and **246**, each projection having a bore **248**, as shown in FIG. **32**. The elevation plate includes a raised portion **250** and bore **243** extends through that raised portion, as shown in FIG. **43**. Projections **244** and **246** on the arbor block sandwich raised portion **250**, and a shaft **242** then passes through bores **248** in the arbor block and bore **243** in the elevation plate to mount the arbor block to the elevation plate. Arbor block **240** may then pivot up and down around shaft **242**.

An arbor **251** is mounted for rotation in arbor block **240**, as shown in FIGS. **28** and **32**, and the blade of the saw is mounted on the arbor so that it spins when the arbor rotates. The arbor is held in two bearings that are mounted in bearing seats in the arbor block. The bearings are isolated electrically from the arbor block by plastic overmolding on the arbor or by insulating bushings. Electrodes are positioned adjacent but not touching the arbor to impart the electrical signal to the blade used in the detection subsystem discussed above. The configuration of the arbor and electrodes are disclosed in detail in U.S. Provisional Patent Application Ser. No. 60/496,550, entitled "Table Saws with Safety Systems and Blade Retraction," filed Aug. 20, 2003, the disclosure of which is hereby incorporated by reference.

Shaft **242** extends outwardly from the right side of the arbor block a sufficient distance so that a brake cartridge **252** may be pivotally mounted on the shaft, as shown in FIG. **30**. The brake cartridge is sized and positioned so that it is adjacent the perimeter of a blade having a specified nominal diameter. The brake cartridge includes a pawl, and the pawl pivots toward the blade around shaft **242** to stop the blade from spinning when the detection subsystem detects that a person has contacted the blade, as described above. The brake

cartridge may be constructed and mounted in the saw in many ways. Examples of how the brake cartridge may be constructed and mounted in a saw are disclosed in U.S. Provisional Patent Application Ser. No. 60/496,574, entitled "Brake Cartridges for Power Equipment," filed Aug. 20, 2003, and U.S. Provisional Patent Application Ser. No. 60/533,575, entitled "Brake Cartridges and Mounting Systems for Brake Cartridges," the disclosures of which are hereby incorporated by reference. That provisional patent application also discloses how the position of the brake cartridge relative to the perimeter of the blade may be adjusted by a linkage between the arbor block and the mounting structure for the brake cartridge. Arbor block **240** includes an aperture **253** through which a bolt may extend to adjust the spacing between the brake cartridge and the blade.

Brake cartridge **252** also acts as a mechanism to prevent a user of the saw from installing a blade larger than recommended. The brake cartridge physically blocks a large blade from being mounted on the arbor because the blade bumps into the brake cartridge.

Arbor **252** includes a pin **254** (labeled in FIG. **32**) that engages an arbor block support mechanism **256** to hold the arbor block up and prevent the arbor block from pivoting around shaft **242** during normal operation of the saw. Pin **254** and arbor block support mechanism **256** also provide rigidity to the arbor block and minimize any vibration of the arbor block during normal operation of the saw. However, when a person accidentally contacts the blade the brake cartridge will engage and stop the blade. The angular momentum of the blade as it is stopped will create a significant downward force and that force will cause pin **254** to disengage from the arbor block support mechanism. When the pin has disengaged, the arbor block will be free to pivot around shaft **242**, so the downward force resulting from stopping the blade will cause the arbor block to pivot down very quickly. The blade will also pivot down because the blade is supported by the arbor block. In this manner, the blade will retract below the tabletop of the saw when a person accidentally contacts the blade.

The arbor block support mechanism is shown in detail in FIGS. **28** and **33** through **36**. An L-shaped bracket **260** is bolted onto surface **262** on the elevation plate (surface **262** is labeled in FIG. **43**). The L-shaped bracket includes a projection **264** having a first surface **266** and a second surface **268**. The first and second surfaces define a corner region **270** into which pin **254** would normally nest. Material from projection **264** may be removed in the corner region to allow pin **254** to contact first and second surfaces **266** and **268** at points that are somewhat distant from each other to better hold the pin. A small pivot arm **272** is mounted on L-bracket **260** so that the pivot arm may pivot around a bolt **274**. The pivot arm includes a tab **276** having a support surface **278**. Support surface **278** also abuts against pin **254** to help hold the pin in place during normal operation of the saw. Pivot arm **272** also includes a distal end **280** shaped to include an aperture through which a shoulder bolt **282** may pass. The shoulder bolt passes through distal end **280** and threads into projection **264** in the L-shaped bracket. A spring **284** and washer **286** are positioned between the head of bolt **282** and distal end **280** of the pivot arm. The spring is sized to bias the pivot arm toward projection **264**. Thus, pin **254** is held in corner **270** by spring **284** pushing pivot arm **272** against the pin. Threading bolt **282** into or out of projection **264** will adjust the force exerted by spring **284** against pin **254**.

When brake cartridge **252** stops the blade, the downward force caused by the angular momentum of the blade will overcome the force of spring **284**, and pin **254** will then push pivot arm **272** aside and move down. Projection **264** includes a third surface **288** that connects with but slopes away from second surface **268**. Third surface **288** slopes away in order to provide clearance for pin **254** to move down. As soon as pin **254** moves down past the point where the third and second surfaces connect, the pin no longer contacts projection **264** so it is free to move down. Similarly, tab **276** on pivot arm **272** is rounded to quickly release pin **254** when the pin begins to move down. The intersection of second surface **268** with third surfaces **288** is positioned substantially opposite the tangent point of the rounded tab **276** so that pin **254** is released from both projection **264** and tab **276** substantially simultaneously.

A bumper or pad **290** is mounted on trunnion brace **134** below arbor block **240**, as shown in FIGS. **5** and **14**. When the arbor block retracts, bumper **290** stops the downward motion of the arbor block and helps absorb the energy of the retraction. The arbor block includes a surface **292** configured to contact bumper **290**, as shown in FIGS. **31** and **32**.

The energy of retraction may be significant. Accordingly, bumper **290** may be selected from materials that have good dampening characteristics and arbor block **240** may be made from a ductile iron so that the arbor block it is less likely to be damaged during retraction. Additionally, trunnion brace **134** should be constructed so that it is sufficiently strong to support bumper **290** and withstand the force of impact with the arbor block.

Trunnion brace **134** and elevation plate **170** are both construction to provide clearance for the arbor block and blade to retract in case of an accident. As shown in FIGS. **14** and **16**, the trunnion brace sweeps down from front trunnion **126** to rear trunnion **128** so that the bottom of the blade will not contact the trunnion brace when the blade is fully retracted. Elevation plate **170** also includes a recessed area **294** (labeled in FIG. **22**) that allows the arbor block to pivot down.

Saw **100** is powered by a motor **300** mounted to the bottom of elevation plate **170**. The motor may be mounted to the elevation plate in many ways. In the depicted embodiment, tabs **302** projects up from the motor and sandwich a projection **304** on the bottom of the elevation plate (projection **304** is labeled in FIGS. **42** and **43**). Bolts **305** and **306** pass through holes in the tabs and projection to mount the motor to the elevation plate, as shown in FIGS. **10** and **11**.

A drive shaft **310** extends from the motor and a pulley **312** is mounted on the drive shaft. A double pulley **314** is mounted on the left end of shaft **242** so that a first belt (not shown) may extend around the motor pulley and the outside of the double pulley. A third pulley **316** is mounted on the left end of arbor **251** and a second belt (not shown) extends around pulley **316** and the inside of double pulley **314**. Motor **300** turns pulley **312**, which then turns double pulley **314** and arbor pulley **316**, causing the blade mounted on the arbor to spin. The depicted embodiment includes a double belt system as described so that arbor block **240** may retract by pivoting down around shaft **242** without disengaging from the drive belts.

Pulleys **314** and **316** are fixed-center pulleys, so a slightly stretchy Poly-V belt designed for fixed center pulleys is used. A slightly stretchy belt also has the advantage of being able to stretch and slip on pulley **316** when the brake cartridge stops the blade. This is advantageous because pulley **316** will stop very suddenly when the brake cartridge stops the blade, but the motor and belts will continue spinning for a short period of time. A stretchy belt will be able to stretch and slip on pulley **316** when the pulley stops suddenly. Of course, other belt and pulley configurations and belt tensioning systems may be used.

The belt around pulley **316** is preferably made of a static dissipative material so that static charge does not build up on the arbor or blade. This is advantageous because in some

implementations a static charge may interfere with the detection subsystem. A standard belt or a slightly stretchy belt may extend around motor pulley **312** and the outside of double pulley **314**. The pulleys may be sized so that the blade spins at a desired speed, such as 4000 rpm, while the motor spins at a different speed, such as 3450 rpm.

The belt extending around the motor pulley and the outside of double pulley **314** may be tensioned by moving the motor out. In the depicted embodiment, motor **300** is mounted to the elevation plate so that it may pivot around bolt **305**. Tabs **302** include an oversized hole **308** through which bolt **306** passes so that the motor may pivot around bolt **305**. To put tension on the belt, bolt **306** is loosened and the motor is pivoted around bolt **305** away from the double pulley. When the desired tension is achieved, bolt **306** is tightened to hold the motor in position.

Trunnion brace **134** is shaped to partially shroud the blade under table **102**. Shrouding the blade prevents a person from contacting the blade under the table. This is useful because if a person contacts the blade under the table, the brake cartridge will fire and the blade will retract, possibly into the person's hand. Shrouding the blade also helps to collect sawdust created when the saw is running.

Trunnion brace **134** is shaped to create a trough or channel **320**, shown in FIG. **15**. The trough is wide enough to shroud the blade and to allow a person to reach into the saw through opening **106** in the tabletop to change either the blade or brake cartridge. Trough **320** is sloped down, as shown in FIGS. **14** and **16**, to direct sawdust toward a port **322** in the bottom of the trough. Preferably, the inside surface of the trough, including the bottom and side walls, is as smooth as possible to avoid trapping sawdust. A hose coupling **324** is mounted to the bottom of the trunnion brace over port **322**. The coupling includes a mesh **326** sized to prevent the bolt and washer with which the blade is secured to the arbor from falling through the mesh. It is possible when a user changes the blade that the blade nut or washer could fall into the saw and become difficult to retrieve. Mesh **326** prevents the bolt or washer from falling where they would be difficult to retrieve. A flexible vacuum hose or other conduit (not shown) is connected to the bottom of the coupling and extends to a similar port on the back of the saw. Thus, sawdust is collected by the blade shroud and then directed out through port **322** and through a conduit to the back of the saw. A user may connect a vacuum system to the port on the back of the saw to collect the sawdust and to create an airflow from the blade shroud to the back of the saw. The hose or conduit between coupling **324** and the port on the back of the saw is flexible so it can move when the trunnion brace tilts.

A side blade shroud **330**, shown in FIGS. **4**, **8**, **10** and **12**, is mounted on trunnion brace **134** to the right of the blade. This shroud further encloses the blade to prevent inadvertent contact with the blade and to collect sawdust. Side shroud **330** is mounted to the trunnion brace by a vertical hinge **332**. The vertical hinge allows the side shroud to pivot out, away from the blade, around the vertical axis of the hinge. Pivoting the side blade shroud out provides additional room to change the blade or brake cartridge. The additional room is especially necessary to slide brake cartridge off of shaft **242**. The side shroud includes magnets **332** to engage the rear trunnion and hold the side shroud closed, although other mechanisms may be used to hold the side shroud closed. The top of the side shroud is shaped and positioned sufficiently away from the underside of the tabletop so that the blade can tilt to the left without the side shroud bumping into the underside of the table.

A front shroud **340** is also mounted on the trunnion brace to the front of the blade. This shroud further helps enclose the blade and direct sawdust to the port in the bottom of the trunnion brace. The right side of this shroud is shorter than the left side in order to allow the blade and trunnion brace to tilt to the left. This shroud would typically be made of a lightweight material to reduce the weight of the saw. Alternatively, the trunnion brace itself may be designed to extend up and form the front blade shroud.

The underside of table **102** may include recesses to allow the blade to rise to a predetermined height without the arbor block bumping into the underside of the table.

The cabinet of the table saw may include in opening to allow access to the internal mechanism of the saw. FIG. **1** shows saw **100** with a cover **342** over such an opening. The cover is mounted to the cabinet with hinges so it can pivot open. A standard latch is used to keep the cover closed. The cover may include louvers to allow airflow into the cabinet.

Saw **100** may also include a switch box **344** with one or more switches to control the operation of the saw. A switch box designed for use with safety systems as described above is described in detail in U.S. Provisional Patent Application Ser. No. 60/533,598, entitled "Switch Box for Power Tools with Safety Systems," the disclosure of which is hereby incorporated by reference.

Saw **100** may also come with a fence **346** that rests on table **102** and clamps to a front rail. The fence provides a face against which a user may slide a work piece when making a cut. One possible fence is disclosed in U.S. Provisional Patent Application Ser. No. 60/533,852, entitled "Improved Fence for Table Saws," the disclosure of which is hereby incorporated by reference. The saw may also come with a miter gauge **348** and a blade wrench **350**.

FIG. **44** shows a table saw with a riving knife **400** positioned adjacent the back edge of the blade. FIGS. **45** and **46** show riving knife **400** in the saw with the cabinet removed, and FIG. **47** shows the riving knife mounted in the saw with the table removed. The riving knife is shown alone in FIGS. **48** and **49**.

Riving knife **400** is a flat, fin-like plate positioned in the saw adjacent the back edge of the blade. The riving knife is mounted in the saw within the projected kerf and top-to-bottom cutting capacity of the blade. Thus, as a workpiece is cut by the blade, the riving knife will fit into the newly cut slot in the workpiece so that it does not block or impede the movement of the workpiece past the blade.

Riving knife **400** functions to prevent a workpiece from engaging the teeth at the back of the blade. As a workpiece is cut into two sections, the newly cut sections may flex or move. If one of the newly cut sections moves to the side and catches the back edge of the spinning blade, the blade may suddenly kick the workpiece back toward the user at a very high speed and the user's hand may be pulled into the blade by the sudden movement of the workpiece. The riving knife impedes the workpiece from moving to the side and thereby minimizes the chance of the workpiece catching the back edge of the blade. The riving knife also minimizes the chance of newly cut sections of a workpiece moving together and binding the blade.

As shown in FIGS. **48** and **49**, the riving knife is flat, smooth and planar. The sides of the riving knife are parallel and the riving knife has a body thickness thinner than the kerf of the blade for which it is intended to be used. The body thickness, however, should not be substantially thinner than the kerf of the blade or the riving knife will be less able to impede a workpiece from catching the back edge of the blade.

Typically, the riving knife has a body thickness thicker than the body thickness of the blade but thinner than the kerf of the blade.

The riving knife includes a leading edge **402** that is curved to follow the edge of whatever blade or blades are intended to be used with the riving knife. Leading edge **402** includes a chamfer **404** so that the edge does not catch on a workpiece as the workpiece is moved past the blade. The riving knife also includes a tip **406** rounded and chamfered so that it does not catch on a workpiece. The rounded tip often has a radius of not less than 0.08 inch. The riving knife typically has a width or dimension from leading edge **402** to a back edge **408** of at least $\frac{1}{6}^{th}$ of the diameter of the smallest blade for which the riving knife is intended to be used, measured at the level of the table top when the riving knife is installed in a saw and raised to its maximum elevation. The riving knife may be made of steel with a hardness of between 38 HRC and 48 HRC and a resistance to rupture at least equal to 800 MPa. The riving knife should be sufficiently rigid so as not to deflect or displace any significant distance toward the blade or to the side.

The riving knife is mounted in the saw close to the blade but not touching the blade. The radial distance between the leading edge **402** and the back of the blade is typically at least 0.11 inch (3 mm) but not more than 0.31 inch (8 mm) at every point along the edge. The highest point of the riving knife is typically at least 0.04 inch (1 mm) but not more than 0.20 inch (5 mm) below the highest point of the saw blade. The riving knife is also mounted in the saw so that it remains in a fixed position relative to the blade as the blade tilts and changes elevation relative to the table. In other words, the riving knife tilts and moves up and down with the blade.

The riving knife may be used for most cuts performed on a table saw, including through-cuts (where the blade cuts through the entire thickness of the workpiece) and non-through-cuts (where the blade does not cut through the entire thickness of the workpiece). There are some cuts, however, where a riving knife may not be used, such as a plunge cut where the blade is raised up into a workpiece and a cove cut where the workpiece is moved past the blade at an angle relative to the plane of the blade so that the blade removes a groove or cove of material. In both those cuts, the riving knife would be outside the cut produced by the blade and would abut the workpiece. Additionally, a riving knife designed for a blade with a 10" diameter should not be used with a smaller diameter blade because the riving knife would project above the cutting capacity of the blade. Similarly, dado blades (which are stacks of blades mounted on the saw to cut a groove in a workpiece) are typically smaller in diameter than normal blades so riving knives designed for normal blades would extend above the dado could not be used because they would abut the workpiece. Dados are also substantially thicker than normal blades and therefore a riving knife designed for a single blade might not impede a workpiece from catching the back edge of a dado stack.

It is desirable for a user to be able to install and remove the riving knife quickly and easily when performing different operations with the saw so that the riving knife is not an inconvenience. For example, if a user needs to make both non-through and dado cuts, then the user will have to remove the riving knife before and re-install it after each dado cut. If it were complicated, difficult or time consuming to remove and reinstall the riving knife between the different cutting operations, then it would be less likely a person would use the riving knife.

The table saw shown in FIGS. **44** through **47** includes a mounting system or mechanism **410** that allows for fast and easy removal and reinstallation of riving knife **400**. Mounting system **410** is shown isolated in FIGS. **50** and **51**.

Mounting system **410** includes a mounting plate **412** that is bolted onto raised portion **250** of elevation plate **170** by bolts **414**, as shown in FIG. **47**. Raised portion **250** is also shown in FIGS. **42** and **43**. Mounting plate **412** is shown isolated from other structure in FIGS. **54** and **55**. Mounting plate **412** includes a flat bottom surface **415** that rests on raised portion **250** of the elevation plate. Two holes **416** pass through the mounting plate and bolts **414** extend through those holes and are threaded into corresponding holes on raised portion **250**. Holes **416** are oversized relative to bolts **414** so that the position of the mounting plate may be adjusted relative to the elevation plate. By adjusting the position of the mounting plate, the position of the riving knife relative to the blade may be adjusted, as will be explained below. Mounting plate **412** also includes a flat face **418** and two holes **420** that pass through the face.

A positioning plate **422** is bolted onto face **418** of mounting plate **412** by bolts **424** that pass through holes **420** and are received into threaded holes **426**. Holes **420** are oversized and oval shaped so that the position of plate **422** may be adjusted. Positioning plate **422** is shown isolated in FIGS. **56** through **58**. Positioning plate **422** functions to position the riving knife in the mounting system. The positioning plate includes a flat surface **428** to support one side of the riving knife and two pins **430** that extend out from that flat surface, as shown. The base of riving knife **400** includes two holes **432** and pins **430** are configured to extend through those holes to locate the riving knife in the mounting system. The positioning plate also includes two flanges **434** extending perpendicularly out from opposite edges of flat surface **428**, and each flange includes a shoulder **436**. Riving knife **400** includes corresponding edges **438** and shoulders **440** configured to position the riving knife between flanges **434** and on shoulders **436** against the positioning plate, as shown in FIG. **70**. Thus, the riving knife is positioned in the mounting system by fitting on pins **430** between flanges **434** and on shoulders **436**.

Mounting system **410** also includes a clamping plate **442** that works with positioning plate **422** to clamp and hold the riving knife in position. Clamping plate **442** includes a flat surface **444** that supports the side of the riving knife opposite the side supported by the positioning plate. Flat surface **444** includes recesses **445** that provide clearance for pins **430** and for contaminants like sawdust so that the clamping plate can abut against the riving knife evenly. The clamping plate also includes shoulders **446** and edges **448** that correspond to shoulders **436** and flanges **434** on the positioning plate so that the clamping plate fits between flanges **434** as shown in FIG. **51**.

Clamping plate **442** also includes a hole **450** through which a bolt **452** passes. Bolt **452** is labeled in FIG. **53**. Bolt **452** passes through hole **450** and is threaded into a hole **454** in positioning plate **422** to loosely connect the clamping plate to the positioning plate. A spring **456**, shown in FIG. **53**, is placed over bolt **452** and is at least partially contained in a first circular recess **458** in positioning plate **422** and in a second circular recess **460** in clamping plate **444**. Spring **456** may be a compression spring, a wave compression spring or some other spring. Spring **456** biases clamping plate **442** away from positioning plate **422** to help open the clamp, as will be described below.

Clamping plate **442** also includes a first set of cam surfaces **462** and **463** and a second set of cam surfaces **464** and **465**. The cam surfaces are positioned in a recess **466** that is concentric with hole **450** and the cam surfaces are arcuately spaced around the hole, as shown. Cam surfaces **462** and **464**

slope up from the bottom of recess **466** to where they join with cam surfaces **463** and **465**, respectively. In the depicted embodiment, each of cam surfaces **462** and **464** is a portion of a helix or coil with a pitch of 50.5 mm. Each of cam surfaces **463** and **464** is a portion of a helix or coil with a pitch of 1.01 mm. Of course, other cam surfaces and pitches may be used. The cam surfaces are used to move clamping plate **442** toward positioning plate **422**, as will be explained.

Mounting system **410** also includes a cam bushing **470** (shown isolated in FIGS. **62** through **65**) configured to fit into recess **466** in the clamping plate. Cam bushing **470** includes cam surfaces **472** and **473** joined by a first edge **471**, and a second set of cam surfaces **474** and **475** joined by a second edge **476**. Those cam surfaces are arcuately spaced around a hole **480**, as shown, and they are configured to correspond roughly with the cam surfaces in the clamping plate. In the depicted embodiment, each of cam surfaces **472** and **474** is a portion of a helix or coil with a pitch of 44 mm. Each of cam surfaces **473** and **475** is a flat surface. Other cam surfaces and pitches may be used. Cam bushing **470** also includes a flange **478** to abut against the front of the clamping plate to limit the distance the bushing may extend into recess **466**.

Cam bushing **470** has an octagon-shaped drive head **482** that can be gripped to turn the bushing and a 12-point inner socket **484** positioned in drive head **482**, as shown in FIG. **62**. Bolt **452** passes through hole **480** in the cam bushing and through hole **450** in the clamping plate and then screws into hole **454** in the positioning plate, as shown in FIG. **53**. The head of bolt **452** may then fit into 12-point inner socket **484**.

Mounting system **410** also includes a handle **490**, shown in FIGS. **66** through **68**. Handle **490** has an elongate body with an 8-facet socket **492** at one end configured to fit over octagon-shaped drive head **482** on cam bushing **470**. A set screw is threaded into a hole **494** on the handle to hold the handle and the cam bushing together when socket **492** is positioned over drive head **482**.

The various components of mounting system **410** described above may be made from various strong and hard materials, such as machined metal, powder metal or cast metal. It is also possible that the components cay be made from a hard plastic or thermoset. The materials of the cam bushing and clamping plate may be selected to facilitate the sliding of the cam surfaces and to minimize galling, and/or the cam surfaces may be lubricated or greased. The cam bushing and handle may be combined into one single part.

Mounting system **410** may be thought of as having an open position where the clamping and positioning plates are spaced apart from each other and a closed position where the two plates are moved closer together. The open position is shown in FIGS. **71** and **72**. In that position, handle **490** is raised and plates **422** and **442** are spaced apart. The mounting system should be configured and adjusted so that in the open position plates **422** and **442** are spaced sufficiently far apart for the riving knife to be moved off of pins **430** and removed from between the plates. The closed position is shown in FIGS. **50**, **51** and **69**. In that position handle **490** is lowered and plates **422** and **442** are closer together to clamp the riving knife and hold it in position.

When handle **490** is moved up to open the clamp, the handle turns cam bushing **470** so that the cam bushing fits into recess **466** on the clamping plate without engaging the cam surfaces. In that position, spring **456** pushes the clamping plate and cam bushing away from positioning plate **422** until the cam bushing abuts the head of bolt **452** and the clamping plate abuts the cam bushing. The distance the clamping plate may move away from the positioning plate can be adjusted by turning bolt **452**. Threading bolt **452** into hole **454** on the positioning plate lessens the distance the clamping plate may move out because it moves the bolt head and cam bushing closer to the clamping plate. Threading the bolt out of hole **454** increases the distance the clamping plate may move out. Bolt **452** may be threaded in or out by pressing the clamping and positioning plates together and pressing the cam bushing into recess **466**. The head of bolt **452** will then extend out beyond the cam bushing so that it may be gripped and turned by hand or with a wrench. When the bolt is adjusted to its desired position, the cam bushing and plates are released and spring **456** pushes them out until the cam bushing abuts the head of the bolt and the bolt head fits into socket **484** in the cam bushing. Socket **484** is a 12-point socket so that the bolt head can fit into the socket in many different positions and thereby allow fine adjustment of the distance bolt **452** is threaded into hole **454**. Spring **456** is sized and selected so that it is at least partially compressed even when the mounting system is in the open position. For example, the spring may be sized and selected so that it applies 5 to 15 pounds of force against the clamping plate in the open position, and more force when compressed. In this manner, the spring biases the clamping plate out so that the mounting system opens when handle **490** is raised.

With mounting system **410** in the open position, riving knife **400** may be placed in the clamp with holes **432** in the riving knife fitting around pins **430** on the positioning plate and shoulders **440** on the riving knife resting on shoulders **436** of the positioning plate, as shown in FIG. **70**. In this manner, the riving knife is positioned in the mounting system. The base of the riving knife includes a cut-out **502** to provide clearance for bolt **452** and spring **456**.

Handle **490** may then be moved down to clamp the riving knife between the positioning and clamping plates. Moving handle **490** down causes cam bushing **470** to turn. When the cam bushing turns, cam surfaces **472** and **474** and/or leading edges **471** and **476** slide up cam surfaces **462** and **464**, respectively, on the clamping plate and push the clamping plate toward the positioning plate. The cam surfaces and/or edges push the clamping plate toward the positioning plate because the cam surfaces are inclined and because bolt **452** prevents the cam bushing from moving out. The cam surfaces are inclined somewhat steeply so that a relatively small rotation of the handle will cause a significant movement of the clamping plate toward the positioning plate. For example, the cam surfaces may be configured to move the clamping plate toward the positioning plate 3/16ths of an inch by moving the handle through only 20-40 degrees of arc. Of course, other configurations and geometries are possible.

When edges **471** and **476** move to the top of cam surfaces **462** and **464**, cam surfaces **473** and **475** on the cam bushing will engage cam surfaces **463** and **465** on the clamping plate. Continued downward rotation of the handle will then cause cam surfaces **473** and **475** to slide over cam surfaces **463** and **465**. These cam surfaces are configured and sized so that when they engage, the cam bushing and clamping plate are stable, with little or no force tending to move the cam surfaces to unclamp the mounting system. In other words, the geometry of the cam surfaces prevents vibration or other factors from causing the mounting system to unclamp or open. One possible configuration is to make cam surfaces **463**, **465**, **473** and **475** relatively flat and smooth with only very little or no slope. Of course, numerous configurations of the cam surfaces are possible and various slopes and shapes may be used depending on the desired movement and clamping action.

As handle **490** rotates down, bolt **452** will unthread from hole **545** and thereby loosen the clamping action. This loosening is not particularly noticeable as cam surfaces **472** and

474 and/or leading edges 471 and 476 slide up cam surfaces 462 and 464 because the cam surfaces move the clamping plate much more than the bolt loosens due to the fact that the pitch of the cam surfaces is much greater than the pitch of the threads on the bolt. However, as cam surfaces 473 and 475 slid over cam surfaces 463 and 465 the loosening of the bolt is more noticeable because those cam surfaces typically do not have a significant pitch. Accordingly, cam surfaces 463 and 465, and/or cam surfaces 473 and 475, may be inclined slightly to match the pitch of the threads on the bolt so that the cam surfaces tighten the clamp in the same amount as the unthreading bolt loosens the clamp. Alternatively, one set of cam surfaces may have a pitch slightly greater than the pitch of the threads on the bolt and the other set of cam surfaces may be flat. This is the configuration shown in the depicted embodiment, where the pitch of the threads on bolt 452 is 1 mm, the pitch of cam surfaces 463 and 465 is 1.01 mm, and cam surfaces 473 and 475 are flat. This configuration tightens the clamp slightly more than the unthreading bolt loosens the clamp. As another alternative, those cam surfaces may incline slightly less than the pitch of the threads on the bolt so that the clamping action is slightly less than the loosening of the clamp by the unthreading of the bolt. In that configuration, the downward movement of the handle becomes slightly easier as the bolt unthreads. This configuration also creates what may be thought of as a slight hump or "detent" that must be overcome when handle 490 is raised to open the clamp, and that hump helps prevent any unintentional opening of the clamp.

Handle 490 also includes a shoulder 496 (shown in FIGS. 66 and 67), and clamping plate 442 includes a boss 500 (shown in FIGS. 60 and 61) adapted to receive a bolt 498 (shown in FIGS. 51 and 52). Shoulder 496 on the handle is adapted to abut against bolt 498 as the handle rotates downward so that bolt acts as a stop to limit the rotation of the handle. Without that stop, the handle could rotate downward until the cam bushing could again fit into recess 466 and thereby allow the clamp to open. Numerous other stops are possible, including a stop integral with the clamping plate.

When included in a saw, mounting system 410 is accessible to a user of the saw through opening 106 in the table, as shown in FIG. 73. Typically, a throat plate or table insert 510 would be positioned in opening 106, as shown in FIGS. 44 and 46. A user would simple remove the throat plate, reach through the opening, grasp handle 490, and move it up or down as required to install or remove the riving knife. Specifically, to install the riving knife a user would simply move handle 490 up to open the mounting system, place the riving knife on the positioning plate, and then move the handle down to clamp the riving knife in place. Handle 490 includes a bend or step 506, labeled in FIG. 68, to move the handle out and away from other components in the saw so that the handle is easy to grasp. Handle 490 may be sized so that it is long enough to extend up through opening 106 and above the tabletop when the mounting system is in the open position with the handle raised, even when the blade is set to its lowest elevation. By so doing, a user would be reminded before using the saw that the riving knife was not clamped into position because the handle would interfere with the throat plate. The geometry of the handle and mounting system may also be configured so that when the handle is moved up, it remains up without falling back down due to gravity.

Mounting system 410 may be adjusted to accommodate riving knives of various thicknesses by adjusting bolt 452, as explained. Threading bolt 452 in or out also adjusts the amount of force applied during clamping.

Mounting system 410 is adapted so that the position of the riving knife relative to the blade may be adjusted. The side-to-side and front-to-back position of the riving knife, as well as the twisting or yaw of the riving knife relative to the blade, may be adjusted to make sure the riving knife is within the kerf of the blade and within the desired radial distance from the back edge of the blade by loosening bolts 414, moving the mounting system as necessary, and then re-tightening the bolts. The elevation or height of the riving knife relative to the blade may be adjusted by loosening bolts 424, moving positioning plate 422 up or down as necessary, and then re-tightening the bolts. The angle or slope of the riving knife toward or away from the back edge of the blade also may be adjusted by loosening bolts 424 and pivoting positioning plate 422 toward or away from the blade, although the amount plate 422 can pivot will depend on the size of holes 420 in mounting bracket 412 and on the size of bolts 424.

Once the position of the mounting system relative to the blade has been set, the riving knife may be removed and re-installed repeatedly without having to re-adjust the position of the riving knife. The riving knife will fit onto positioning plate 422 and the clamping action of the mounting system will press the riving knife against surface 428 of on the positioning plate, thereby locating the riving knife in the same position each time it is re-installed into the mounting system. A user may therefore remove the riving knife when necessary for a given operation and replace the riving knife quickly and easily without tools and without having to re-adjust the position of the riving knife. The ability of the mounting system to position the riving knife accurately when it is re-installed may be thought of as indexing the riving knife to a predetermined position.

As stated above, mounting system 410 is mounted on portion 250 of elevation plate 170. Mounting the mounting system on the elevation plate means that the mounting system and riving knife will move up and down and tilt with the blade as the blade moves. Thus, the position of the riving knife relative to the blade remains constant as the position of the blade relative to the table changes.

Mounting system 410 is constructed so that items other than a riving knife may be attached to or mounted in the saw. Any item that includes a base configured to fit over positioning plate 422 and sized to be clamped between the positioning plate and clamping plate 442 may be mounted and indexed in the saw as described.

Blade guard assembly 108 is another item that may be mounted and indexed in mounting system 410. Blade guard 108 is shown isolated in FIGS. 74 through 81. Blade guard 108 includes a blade shroud 520 shaped to fit over the blade and shield a person from accidentally contacting the blade. The shroud forms a cavity in which the blade may spin. The shroud is made from a nonconductive material such as polycarbonate or some other plastic so that the shroud will not affect any electrical signal on the blade if the shroud comes into contact with the blade and if the saw includes a contact detection system as described above. (In fact, blade guard 108 is constructed so that no metal or conductive part of the guard can contact the blade.) The material of the shroud should be sufficiently soft so that it will be unlikely to damage the blade if the shroud comes into contact with the blade. Often shroud 520 is made of a clear plastic so that the blade can be seen through the shroud and especially so that the cutting edge of the blade can be seen through the shroud by an operator of the saw. Shroud 520 is made from two halves joined together by screws, nuts and bolts, sonic welding, adhesive, clips or some other method or it can be a single molded piece.

The bottom of each side of blade shroud **520** includes a flat edge **522** adapted to rest on tabletop **102** when the blade is set at 90-degrees relative to the table top. Alternatively, the bottom edge of one side may be raised slightly to accommodate when the blade tilts relative to the tabletop. The left bottom edge when facing the saw in the normal operating position would be raised for a left-tilting saw and the right bottom edge would be raised for a right-tilting saw. In this configuration, if one bottom edge rests on the tabletop when the blade is set at 90-degrees, the other bottom edge typically would rest on the tabletop when the blade is tilted to 45-degrees.

Blade shroud **520** also includes a top edge **524** shaped to curve closely around the blade. The spacing between the perimeter of the blade when it is fully elevated and the inside surface of the blade shroud at the closest point can be approximately ¼ to ½ inch, for example, although other spacings are possible. The top edge of the blade shroud follows closely to the curve of the blade when the blade is fully elevated in order to minimize the size of the shroud, to create a substantially smooth and curved inside surface for dust collection, and to present a pleasing appearance.

A front portion **526** of the blade shroud extends up and out from the shroud, as shown, and may be thought of as a horn. Front portion **526** extends up to provide a contact surface for a workpiece to abut as the workpiece moves toward the blade. When the workpiece abuts the front portion, the workpiece will push the guard up to allow the workpiece to slide under the guard and past the blade. Front portion **526** is sized to accommodate the maximum cutting depth of the saw, which, for example, is often 3.125 inches. In other words, front portion **526** is sized so that the thickest workpiece that can be cut on the saw will abut the surface and push the guard up. The front portion is angled so that the workpiece will not catch on the shroud when the workpiece moves toward the blade. A wall or barrier **527** (labeled in FIG. **79**) may be molded into the shroud between the main inside cavity of the shroud and the front portion so that sawdust does not collect in the front portion.

Bottom edges **522** of the blade shroud also include inwardly projecting flanges **532**, one on each side, as shown in FIGS. **79** and **80**, that add strength to the shroud. (FIG. **80** shows a front view of the blade guard). Flanges **532** also will abut the blade if the shroud deflects to the side, thereby protecting the shroud from the blade by minimizing the region over which the blade contacts the shroud.

Blade shroud **520** is also configured to fit closely to the sides of the blade, as shown in FIGS. **78** and **79** which show top and bottom views, respectively, of blade guard **108** and blade shroud **520**. A right side **528** and a left side **530** of the blade shroud are shown in those figures. The inside spacing between those sides can vary from approximately ¼ inch at the closest point to approximately ¾ or 1 inch at the widest point. The front of the blade shroud has a wider dimension than the rear because the blade shroud will have more play or side-to-side movement at the front than at the rear, as will be explained.

The right side of the blade shroud is configured as close to the blade as possible so that the fence of the table saw can be moved as close as possible to the blade before bumping into the guard. The right side of the blade shroud is flatter than the left side, as shown in FIG. **78**, because the fence is typically used on the right side of the blade. Configuring the shroud to be close to the sides of the blade, and particularly close to the right side of the blade, allows the guard to be used when the fence must be positioned close to the blade.

The configuration of blade shroud **520** described herein may be thought of as a low-profile configuration because the shroud fits closely around the blade. This low-profile configuration reduces the degree that the blade guard interferes with the operation of the saw and is less obtrusive than other guards. Making the blade guard and blade shroud as small and unobtrusive as possible increases the likelihood that the guard will be used and will not be removed by a user of the saw. The low-profile guard also minimizes the regions in which sawdust may collect and directs sawdust to a collection area below the tabletop of the saw.

Blade shroud **520** is pivotally connected to a support arm **536**. Support arm **536** is a folded metal arm with a U-shaped cross section, and is shown isolated in FIG. **82**. Support arm **536** includes a first tab **538** with a first hole **540** and a second tab **542** with a second hole **544**. Tabs **538** and **542** are adapted to fit over and around a designated portion of blade shroud **520**. Specifically, blade shroud **520** includes a hole **546** near the top edge of the shroud (as shown in FIG. **84**) and support arm **536** is adapted to fit over the shroud so that holes **540** and **544** in the support arm align with hole **546** in the shroud. Hole **546** extends through a boss that spans the shroud from one side to the other. A steel pin **548** extends through the holes to pivotally connect the blade shroud to the support arm.

Pin **548** is shown in FIG. **86**. Pin **548** includes a main section **550** that is lightly press fit into hole **546** in the blade shroud so that the pin is held snug and securely by the blade shroud so that there is no play between the blade shroud and the pin. Main section **550** of the pin has a diameter sized to fit securely into second hole **544** in the support arm so that the pin can rotate in the hole with very little play. The end of pin **548** that fits into hole **544** is substantially flush with the outside surface of the support arm when the pin is positioned properly so as not to increase the side-to-side dimension of the overall blade guard.

Pin **548** also includes a first recessed section **552** and a second recessed section **554**. The change in diameter from main section **550** to first recessed section **552** creates a shoulder **555** that abuts against the inside surface of tab **538** on the support arm. The diameter of hole **540** in tab **538** is sized to accept first recessed portion **552** so that the pin can rotate in the hole with very little play, but the diameter of hole **540** is smaller than the diameter of main section **550**. In this manner, the position of shoulder **555** defines the position of the pin in holes **540** and **544**. The length of main section **550** is substantially equal to the distance between the inside surface of tab **540** and the outside surface of tab **542**. Second recessed portion **554** is configured to receive a clip **556** to hold the pin in place. FIG. **87** shows clip **556** on pin **548**, and FIGS. **87** and **88** both show the pivot connection between blade shroud **520** and support arm **536**.

The pivot connection between blade shroud **520** and support arm **536** allows for a metal-to-metal pivot rather than a metal-to-plastic pivot because tabs **538** and **542** in the support arm contact pivot pin **548**. Having a metal-to-metal pivot connection permits the connection to be more precise than it otherwise could be because the metal components may be manufactured with smaller or tighter tolerances and because the metal-to-metal pivot connection will wear less than other connections. This is important because a more precise pivot connection means there will be less play, vibration or side-to-side movement of the blade guard.

Support arm **536** is also designed to have a significant width or side-to-side dimension between tabs **538** and **542**. That width provides stability for the blade shroud and minimizes the play, vibration, and side-to-side movement that could otherwise result. One possible width or side-to-side dimension of support arm **536** is around 1.5 inches, although other dimensions are possible. Making support arm **536** rela-

tively wide, however, means that the support arm is wider than the blade shroud. Accordingly, left side **530** of the blade shroud includes a raised portion **560** so that the blade shroud fits and substantially fills the space between tabs **538** and **542** on the support arm, as shown in FIGS. **79** and **80**. Raised portion **560** also includes flat outside surfaces to minimize or eliminate any interference with the inside surfaces of tabs **538** and **542** on the support arm when the blade shroud pivots around pin **548**. Hole **546** in the blade shroud passes through raised portion **560**. Typically, there would be some minimal clearance between the inside surfaces of the support arm and the outside surfaces of the blade shroud so there is no friction or drag between them when the shroud pivots. Alternatively, the size of raised portion **560** and the resulting side-to-side dimension of the blade shroud can be selected to create a desired amount of friction between the blade shroud and the support arm so that a predetermined amount of force is required to pivot the blade shroud.

Tabs **538** and **542** on the support arm create an open region **562** that provides clearance for the blade shroud to pivot. Open region **562** is limited by edge **564** and upper surface **566**. Blade shroud **520** includes a projection **568** that acts as a stop to limit the counterclockwise rotation of the blade shroud when viewed as in FIG. **76**. Projection **568** includes a curved surface **570** and a tab **572** extends out from surface **570**. Projection **568** is sized so that curved surface **570** slides past edge **564** in the support arm when the blade shroud pivots, but tab **572** abuts upper surface **566** on the support arm when a predetermined amount of rotation has occurred.

The clockwise rotation of blade shroud **520** when the shroud is viewed as in FIG. **76** is limited by a flange **574** cut out of the upper surface of support arm **536**. Flange **574** is bent down toward the blade shroud, as shown in FIG. **82**, so that the back of top edge **524** on the shroud will contact the flange after the blade shroud has rotated a given amount relative to the support arm.

The end of support arm **536** opposite tabs **538** and **542** is pivotally connected to a spreader or splitter **580**. Splitter **580** is a flat, metal plate similar to the riving knife discussed above. The splitter has a side-to-side thickness thinner than the kerf of the blades for which it is intended to be used and the splitter is positioned in the saw behind and within the kerf of the blade, like the riving knife. The splitter, however, extends above the height of the fully elevated blade so that a blade shroud may be mounted thereto.

Splitter **580** includes a front edge **582** curved to follow the perimeter of the blades with which the splitter is to be used, like the leading edge of the riving knife discussed above. The splitter also includes a rounded tip **584** similar to the tip of a riving knife. Curved edge **582** and tip **584** are chamfered so that they do not catch on a workpiece. Splitter **580** also includes an upper edge **586** extending up and away from tip **584** and a portion of that upper edge is chamfered. Splitter **580** includes a base **588** with shoulders, edges, holes and cutouts like those in the riving knife discussed above so that the splitter may fit into mounting system **410**, as shown in FIGS. **89** and **90**.

Support arm **536** includes two side walls **590** and **592** (labeled in FIG. **82**) and two holes **594** and **596** are cut in the side walls at the end of the support arm opposite tabs **538** and **542**. A corresponding hole **598** is positioned in splitter **580** toward the top and back of the splitter. Support arm **536** is positioned over the splitter so that hole **594** and **596** align with hole **598**. A nut **600** (shown in the assembly in FIG. **81** and isolated in FIG. **91**) is positioned between the splitter and side wall **592** of the support arm. Nut **600** includes a recessed section **602** with a shoulder **604**. Recessed section **602** is sized to fit into hole **596** without any significant play. Recessed area **602** is also sized so that it preferably does not extend through hole **596** beyond the outer surface of wall **592** so as to minimize the overall width of the blade guard assembly. Shoulder **604** is sized larger than hole **596** so that the shoulder abuts the inside surface of wall **592**. Nut **600** also includes a threaded hole **605** to receive a screw, as will be explained.

A spacer **606** (shown in FIGS. **81** and **92**) is positioned between splitter **580** and wall **590** of support arm **536**. Spacer **606** includes a recessed section **608** with a shoulder **610**, and recessed area **608** is sized to fit into hole **594** without any significant play. Recessed area **608** is sufficiently long so that it extends through hole **594** and slightly beyond the outer surface of wall **590**. Shoulder **610** is sized larger than hole **594** so that the shoulder abuts the inside surface of wall **590**. Spacer **600** also includes a hole **612** through which a screw may pass.

A screw **614** (shown in FIG. **81**) passes through a lock washer **616** and a flat washer **618** and then through spacer **600** and hole **598** in the splitter to thread into nut **600**. As screw **614** threads into nut **600**, the nut is drawn against the splitter and the washer and lock washer are drawn against the end of spacer **606** that extends through hole **594**. Thus, threading the screw into nut **600** causes the nut and spacer to clamp the splitter around hole **598** and thereby pivotally mount the support arm on the splitter.

The pivot connection between splitter **580** and support arm **536** is a metal-to-metal pivot, as with the pivot connection between blade shroud **520** and support arm **536**, because holes **594** and **596** in the support arm contact the recessed areas or shoulders on nut **600** and metal spacer **606**. Having a metal-to-metal pivot connection permits the connection to be more precise than it otherwise could be because the metal components may be manufactured with smaller or tighter tolerances and because the metal-to-metal pivot connection will wear less than other connections. This is important because a more precise pivot connection means there will be less play, vibration or side-to-side movement of the blade guard.

Support arm **536** includes a cutout **620** to provide clearance for the splitter when the support arm pivots up. The size of the cut out will determine how far upward the support arm can pivot. In the depicted embodiment, cutout **620** is sized to abut the top edge of the splitter when the support arm and blade shroud are pivoted up to a point where the center of mass of the support arm and blade shroud are behind hole **598** (or to the right of hole **598** when the blade guard is viewed as in FIG. **93**), regardless of the pivot position of the blade shroud relative to the support arm. In that configuration, gravity will cause the blade guard to stay up when a user pivots the guard to its uppermost limit, as shown in FIG. **93**.

Blade shroud **520** includes a slot **622**, shown in FIG. **85**, extending along the back edge of the shroud from the bottom edge up toward the pivot connection with the support arm. Slot **622** is positioned in the side-to-side center of the shroud. Slot **622** is configured so that when the blade shroud is lowered to cover the blade, the splitter fits into slot **622**, as shown in FIGS. **74** through **77** and FIG. **90**. The width of the slot is sized so that the edges of the slot are close to the sides of the splitter. By having the splitter extend into the slot in the shroud, the splitter helps stabilize the shroud and prevents the shroud from moving to the side. If the shroud starts to move to the side, an edge of the slot will abut splitter and stop that motion before the shroud contacts the blade. The slot is long enough so that the splitter stays in the slot as the blade shroud pivots up to accommodate a workpiece. Slot **622** also includes

an opening **624** at the bottom of the blade shroud that includes angled or chamfered sides, as shown in FIGS. **79**, **81** and **85**, to direct the splitter into the slot as the blade shroud is lowered.

With this configuration, the forward portion of the splitter may be thought of as supporting or stabilizing the guard or blade shroud. This configuration may also be thought of as having the splitter and blade shroud interact to stabilize the back end of the shroud. Stabilizing the shroud with the splitter lets the shroud have a relatively small side-to-side dimension at the back of the shroud.

In use, as a person feeds a workpiece toward the blade of the saw, the workpiece will contact the blade guard and push the blade shroud up. The blade shroud will pivot around pin **548** and the blade shroud and support arm will move up by pivoting around screw **614**. The blade shroud will be stabilized by the wide pivot connections and the splitter. The blade shroud will move up until the workpiece can slide under and past the guard, at which time gravity will cause the shroud to move down and rest on the tabletop. Additionally, support arm **536** and blade shroud **520** will pivot up and down relative to splitter **580** when the blade moves up and down because the splitter is mounted in mounting system **410** and will therefore move with the blade, as explained. For example, as the blade and splitter move down, support arm **536** and blade shroud **520** will pivot up relative to the splitter because the blade shroud rests on the tabletop.

In the depicted embodiment, the vertical dimension of splitter **580** and the position of hole **598** in the splitter are selected to position support arm **536** so that the pivot point is approximately centered in the range of motion of the support arm. In other words, beginning with the splitter fully elevated and then moving the splitter to its fully retracted position, the support arm will pivot roughly the same amounts above and below a horizontal position. Centering the pivot point in the range of motion of the pivot arm minimizes any front-to-back motion of the blade shroud as the splitter moves up and down. Of course, the splitter may be configured to position the support arm differently. The vertical dimension of splitter **580** and the position of hole **598** are also selected to be higher than the maximum cutting depth of the saw so that a thick workpiece can be slid past the splitter without bumping into support arm **536**. The location where the support arm connects to the blade shroud in the depicted embodiment is chosen to minimize the length of the support arm while still holding the blade shroud in its desired position and while still providing stability to the blade shroud. Minimizing the length of the support arm minimizes the effect on the blade shroud of any play in the connection between the support arm and the splitter. The position of flange **574** in the support arm and the distance the flange extends down toward the blade shroud are selected so that the flange is close to the top of the shroud when the splitter is fully retracted. The flange will prevent the blade shroud and support arm from folding up, especially when a workpiece contacts the shroud with the splitter retracted.

Stabilizing the back of the blade shroud with the splitter; securing the blade shroud to the support arm with a relatively wide, metal-to-metal pivot connection; and clamping the support arm to the splitter with a relatively wide, metal-to-metal pivot connection results in a blade guard that is stable and that has little side-to-side play. This stability allows for a low-profile guard as described that interferes less with the operation of the saw, is less intrusive, and is more functional than other guards and therefore is more likely to be used.

In the depicted embodiment, the overall width or side-to-side dimension of blade guard **108** is substantially defined by the width of support arm **536**, as shown in FIGS. **78** through **81**, and blade shroud **520** is contained within that width. Screw heads and pins used in the depicted embodiment extend beyond the left side of the support arm rather than the right, to the extent possible, so that the fence can be positioned as close as possible to the right side of the guard.

Blade guard **108** can also include anti-kickback pawls **630**, one pawl mounted to each side of splitter **580**, as shown in FIGS. **74** through **77** and FIG. **94**. The anti-kickback pawls are mounted to the splitter by a bolt **632** that extends through holes in the pawls, through spacers **634**, and through a hole **634** in the splitter, as shown in FIG. **81**. Bolt **632** then screws into nut **638**. Bolt **632** may be a flat head bolt or it may be countersunk if possible to minimize the distance it extends beyond the outer surface of support arm **536**. Washers may be placed between the bolt head and pawl and between the nut and pawl. Spacers **634** may have shoulders so that the bolt and nut tighten against the spacers and clamp the spacers to the splitter. The anti-kickback paws would then rest on the shoulder of the spacers. A torsion spring **640** may be placed over the spacers and over the top of the splitter with an end connecting to each of the two anti-kickback pawls, as shown in FIGS. **81** and **94**. The torsion spring biases the pawls toward the tabletop of the saw. A spring pin **642** is placed through a hole **644** in the splitter to limit the forward movement of the anti-kickback pawls. Each side of support arm **536** includes a recess **645** to provide clearance for bolt **632**, spacers **634** and spring **640**.

When a user feeds a workpiece into the saw, the workpiece will move past the blade and contact the anti-kickback pawls and push them up so that the workpiece can continue to slide past the pawls. The anti-kickback pawls are mounted to the splitter above the maximum cutting depth of the saw so that the pawls do not block a workpiece.

The anti-kickback pawls are configured so that if a workpiece is pulled back or if a force tries to move the workpiece toward the front of the saw, the anti-kickback pawls will resist that movement. Specifically, the anti-kickback pawls include teeth that are angled so a workpiece may slide past the pawls toward the rear of the saw but the teeth will bite into the workpiece if the workpiece moves toward the front of the saw. The pawls are also shaped so that they will bind against the workpiece when the workpiece moves toward the front of the saw. Each anti-kickback pawl has a sufficient number of teeth so that at least one tooth will engage a workpiece regardless of the elevation of the splitter. The teeth are configured so that their approach or bite angle remains around 45 degrees and preferably around 60 degrees regardless of the elevation of the splitter.

The anti-kickback pawls in the depicted embodiment are positioned behind and outside the blade shroud rather than inside the blade shroud. The blade shroud does not extend back over the anti-kickback pawls. The anti-kickback pawls are also configured to be within the width or side-to-side dimension of support arm **536**, as shown in FIG. **81**. This configuration contributes to the blade guard having a low-profile and to the blade shroud being at least partially stabilized by the leading edge of the splitter, as explained.

The anti-kickback pawls are mounted on the splitter and therefore will move up and down with the splitter. As the splitter moves up and down, the anti-kickback pawls will contact and slide on the tabletop or table insert. Thus, the tabletop or insert should have a surface to accommodate the sliding of the teeth of the anti-kickback pawls thereon. In the depicted embodiment, the anti-kickback pawls are configured so that they contact the insert only; they do not contact table **102**.

A throat plate or table insert **510** is shown isolated in FIGS. **95** through **97**. Insert **510** is configured to fit in opening **106** in table **102** and the insert is adapted for use with the detection and reaction systems described above, with mounting system **410**, with riving knife **400** and with blade guard **108**.

Insert **510** is made from a non-conductive, hard material such as phenolic so that it does not affect or interfere with any electrical signal on the blade. The insert may also be made from other hard, non-conductive materials. If the insert were conductive, then contact with the blade would likely ground out any signal on the blade and cause a reaction system to trigger. The insert can also be made from a relatively softer material such as nylon with a support plate or bracket molded in the insert or otherwise associated therewith to give the insert rigidity.

Insert **510** includes a right portion **650** and a left portion **652**, which are separate pieces. Right portion **650** is shown individually in FIGS. **98** through **100** and left portion **652** is shown by itself in FIGS. **101** through **103**. Typically a table insert for a table saw is a single piece, but insert **510** is a two-piece insert to accommodate blade guard **108** and mounting system **410**. For example, to mount blade guard **108** in mounting system **410** a user must remove the table insert to clamp the blade guard in position. However, with the blade guard clamped in position, a one-piece insert could not be placed in the table opening unless the insert had a slot big enough to fit around or over the blade guard. But if the insert had such a slot, then the insert would be weak and more likely to break. Using a two-piece insert addresses this issue because only one piece of the insert would need to be removed to install the blade guard; the other portion of the insert would remain in place. In the depicted embodiment, removing right portion **650** of insert **510** from table opening **106** provides sufficient clearance for the blade guard to be mounted in the saw; left portion **652** of the insert need not be removed. Right portion **650** can then be reinserted into the table opening after the guard is mounted in the saw because right portion **650** does not wrap around the blade guard; it extends along one side of the guard only.

A two-piece insert may take many different forms. In the depicted embodiment, right portion **650** and left portion **652** abut along a seam **654** which extends from the front of the insert to a predetermined point down the length of the insert. A slot **656** then extends from the terminus of seam **654** to the rear of the insert, as shown. Slot **656** is not long enough to allow the blade to extend up through the insert, so a slot must be cut in the insert to accommodate the blade when the insert is first placed in the saw. A slot is cut in the insert by lowering the blade below the tabletop, inserting and securing the insert in the table opening, and then turning the saw on and raising the spinning blade through the insert.

An insert in which at least a portion of the blade slot is cut by the blade itself is called a zero-clearance insert because the insert comes close to the sides of the blade with almost zero clearance. A zero-clearance insert has the advantage of supporting a workpiece close to the blade to minimize any chipping of the workpiece that may occur during cutting.

Slot **656** is pre-formed in insert **510** and the length of the slot may vary depending on how much of the slot is to be cut by the blade, if any. Slot **656**, as shown in FIGS. **95** through **97**, is long enough to allow a user to cut the slot with a riving knife installed in the saw because slot **656** is long enough to provide clearance for the riving knife as the blade rises up through the insert. Alternatively, slot **656** may be shortened so that the riving knife must be removed before the slot is cut. In that case, slot **656** could extend only far enough to allow a riving knife or blade guard to extend above the insert after the blade has cut the slot in the insert. As still another alternative, slot **656** could extend sufficiently far so that the blade need not cut a slot in the insert at all. In that case, the insert probably would not be thought of as a zero-clearance insert.

Rights portion **650** of insert **510** is larger than left portion **652** because opening **106** in the table is larger to the right of the blade than to the left. Opening **106** is larger to the right of the blade so that a user may replace the blade, change the brake cartridge, or change between the riving knife and the blade guard through the opening, as described. Left portion **652** is sized to provide some clearance between the blade and the table and to provide additional room to adjust the position of mounting system **410** on the elevation plate when necessary.

Opening **106** in table **102** includes several support surfaces or pads **658** spaced around the periphery of the opening as shown in FIG. **73**, and insert **510** rests on and is secured to those pads. Specifically, two screws **660** pass through right portion **650**, one at each end, and they screw into threaded holes **662** in two of the pads **658**. Two screws **664** pass through left portion **652** and they screw into threaded holes **668**. One of the holes in each of the right and left portions of the insert may be oversized to facilitate the aligning of the screws with the holes in light of manufacturing tolerances. In the depicted embodiment, the holes to the back or rear of each of the right and left portions of the insert are oversized. The screws are countersunk into the insert so they do not extend above the surface of the insert. In this manner, the right and left portions of insert **510** are secured in opening **106** and prevented from being accidentally knocked out of the opening by the spinning blade.

Right portion **650** is also secured in opening **106** by a flange **670** that fits under a shoulder or edge of table **102**. The flange prevents the back end of right portion **650** from moving up and out of the opening. Flange **670** must be tucked under its corresponding shoulder when the insert is placed in the table opening. Right portion **650** also includes a catch **672** made from a projection that fits into and presses against a detent **674** in left portion **652**, as shown. Catch **672** may take many forms, including a spring-biased ball that provides friction against the edge of left portion **652**, a snap fit, a magnet catch, etc. Flange **670** and catch **672** are provided as an additional or alternative means to secure right portion **650** in opening **106** because some users may not use the screws to secure the right portion in the opening. They may not use the screws if they need to remove the right portion of the insert frequently to change blades, change the brake cartridge, or switch between the riving knife and blade guard. In that situation, it would be inconvenient to repeatedly screw and unscrew the right portion of the insert in the table opening, so flange **670** and catch **672** are used to hold the right portion in place.

Right portion **650** also includes a finger hole **680**. A user may insert their finger into the hole to remove the right portion of the insert from the table opening.

Right portion **650** and left portion **652** include leveling screws **682** to level the insert relative to the tabletop. There are four leveling screws in right portion **650** and three leveling screws in left portion **652**. The leveling screws are positioned over and rest against selected ones of pads **658**. The leveling screws are spaced apart as shown in order to provide both front-to-back and side-to-side leveling and to help stabilize the insert.

The side-to-side position of insert **510** in opening **106** can be adjusted by a screw threaded into a hole **690** on the outside edge of right portion **650**. (Hole **690** is labeled in FIG. **100**.) The screw can be threaded into the hole so that it extends slightly beyond the outside edge of the insert to increase the

overall side-to-side dimension of the insert. The front-to-back position of the insert can be similarly adjusted by a screw threaded into a hole **692** in the front edge of right portion **650**. Additionally, the outer edge of left portion **652** includes two slightly raised pads **694** that abut the corresponding inner edge of opening **106** to help position the insert in the opening.

Insert **510** also includes two metal plates **698** and **700** mounted on the top surface of the insert at the back end with one pad on each side of slot **656**, as shown in FIGS. **95** and **96**. Plates **698** and **700** may be attached to the right and left portions of the insert, respectively, in many ways, such as by gluing. The metal plates are the surfaces on which the anti-kickback pawls described above may slide. The plates prevent the anti-kickback pawls from catching on or scratching the insert and the tabletop.

The top surface of insert **510** is typically made of a hard, non-conductive material such as melamine and it is often colored to contrast with the tabletop.

The underside of right portion **650** includes a recessed section **702** along the edge of slot **656** and seam **654**, as shown in FIG. **97**. The recessed section slopes back from the edge like a chamfer and provides clearance for the blade when the blade tilts. Recessed section **702** and insert **502** are designed for a left-tilting saw. The configuration could be mirrored for a right-tilting saw. The underside of right portion **650** also includes a recessed area **704** to provide clearance for the arbor and the blade washer and nut when the blade is fully elevated. The underside of left portion **652** also includes a recess **706** to provide clearance for the arbor block when the blade is fully elevated. The undersides of both the right and left portions of the insert may also include other recessed sections to minimize the mass of the part or to provide flattened or smoothed areas to rest on pads **658**. The recessed or smoothed areas may be made by machining, molding or some other method.

## INDUSTRIAL APPLICABILITY

The systems, mechanisms and components disclosed herein are applicable to power equipment, and particularly to table saws, including cabinet saws, contractor saws, hybrid saws, jobsite saws, and bench top saws.

It is believed that the disclosure set forth above encompasses multiple distinct inventions with independent utility. While each of these inventions has been disclosed in its preferred form, the specific embodiments thereof as disclosed and illustrated herein are not to be considered in a limiting sense as numerous variations are possible. The subject matter of the inventions includes all novel and non-obvious combinations and sub-combinations of the various elements, features, functions and/or properties disclosed herein. No single feature, function, element or property of the disclosed embodiments is essential to all of the disclosed inventions. Similarly, where the claims recite "a" or "a first" element of the equivalent thereof, such claims should be understood to include incorporation of one or more such elements, neither requiring nor excluding two or more such elements.

It is believed that the following claims particularly point out certain combinations and sub-combinations that are directed to one of the disclosed inventions and are novel and non-obvious. Inventions embodied in other combinations and sub-combinations of features, functions, elements and/or properties may be claimed through amendment of the present claims or presentation of new claims in this or a related application. Such amended or new claims, whether they are directed to a different invention or directed to the same invention, whether different, broader, narrower or equal in scope to the original claims, are also regarded as included within the subject matter of the inventions of the present disclosure.

The invention claimed is:

**1**. A table saw comprising:

a table defining a work surface, where the table includes an opening;

a generally planar, circular blade configured to extend at least partially above the work surface through the opening;

a motor to drive the blade;

a riving knife or splitter having a substantially planar base portion with opposing sides;

an elevation carriage supporting the blade and configured to move to change the elevation of the blade relative to the work surface with the blade at a specific angular orientation relative to the work surface;

a mounting system configured to hold the riving knife or splitter adjacent the blade with the opposing sides of the base portion substantially parallel to the plane of the blade;

where the mounting system is supported to move with the elevation carriage;

where the mounting system includes a clamping structure adapted to open and to close;

where the clamping structure includes a first clamp surface, a second clamp surface spaced apart from the first clamp surface to accommodate the base portion between the clamp surfaces with the opposing sides of the base portion generally adjacent the first and second clamp surfaces, a handle adapted to pivot around an axis below the work surface between a first position where the clamping structure is open and a second position where the clamping structure is closed, a cam surface configured to convert pivotal motion of the handle into generally linear motion of at least one clamp surface toward the other clamp surface, the cam surface having an end, and a detent adjacent the end of the cam surface and configured to prevent unintentional opening of the clamping structure;

where pivoting the handle from the first position to the second position causes at least one clamp surface to move toward the other and clamp the opposing sides of the base portion;

where the handle can be pivoted by hand from one of the first position and second position to the other without using tools and without having to pivot the handle more than one full revolution;

where the handle is constrained from pivoting through more than one full revolution;

where the first and second clamp surfaces are below the work surface; and

where the handle and opening in the table are configured so that a user can access the handle by reaching a hand through the opening.

**2**. A method of installing a riving knife or splitter in a table saw, where the table saw comprises a table defining a work surface, an opening in the table, and a generally planar, circular blade configured to extend at least partially above the work surface through the opening, and where the riving knife or splitter has a base portion with opposing sides substantially parallel to the plane of the bade, and where the table saw also has a clamping structure adapted to clamp the opposing sides of the base portion, and where the clamping structure includes first and second clamping surfaces, a handle adapted to pivot around an axis below the work surface between a first position where the clamping structure is open and a second position where the clamping structure is closed, a cam surface config-

ured to convert pivotal motion of the handle into generally linear motion of at least one clamp surface toward the other clamp surface the cam surface having an end, and a detent adjacent the end of the cam surface and configured to prevent unintentional opening of the clamping structure, the method comprising:

providing a riving knife or splitter having a base portion with opposing sides;

positioning the handle in the first position where the clamping structure is open;

positioning the base portion of the riving knife or splitter between the first and second clamping surfaces with the opposing sides of the base portion substantially parallel the plane of the blade;

grasping the handle by reaching through the opening in the table; and

pivoting the handle by hand through less than 360-degrees to the second position where the clamping structure is closed and where the detent prevents unintentional opening of the clamping structure.

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